terraphase engineering

October 16, 2018

U.S. Environmental Protection Agency, Region 9
Water Enforcement Section II
75 Hawthorne Street (ENF 3-2)
San Francisco, CA 94105-3901

Attention: Lawrence Torres

Subject: Submittal of Draft Sediment Remediation Plan and Revised Draft Ecological Risk Assessment
Sims Group USA Corporation, Redwood City, California

Dear Mr. Torres:

On behalf of Sims Group USA Corporation (Sims), Terraphase Engineering Inc. (Terraphase) is pleased to submit to the U. S. Environmental Protection Agency (EPA) the Draft Sediment Remediation Plan (Draft SRP) in accordance with Paragraphs 18 and 19 of the Consent Decree between Sims and EPA, effective December 1, 2014 (Case 3:14-cv-04209).

Draft Sediment Remediation Plan

The Draft SRP was prepared based on the results of the *Final Sediment Investigation Report,* dated March 1, 2018, and includes an evaluation of various alternatives for remediation of impacted sediments in the immediate vicinity of the ship-loading conveyor at Sims's facility in Redwood City. The remedial alternatives reviewed in the SRP take into consideration the potential environmental impacts associated with disturbance of the sediment that may result from one or more of such remedial alternatives.

The Draft SRP evaluated remedial alternatives for both the riprap and subtidal areas within the Project Area. The preferred remedial alternatives for the riprap and subtidal areas are the placement of a sand cap and micro-dredging (diver-assisted dredging), respectively, in the areas of highest constituent concentrations, as identified in EPA's letter to Sims, dated August 23, 2018.

Revised Draft Ecological Risk Assessment

Sims submitted a Draft Ecological Risk Assessment (ERA) to the EPA on March 1, 2018. The approach and findings of the Draft ERA were discussed with the EPA during a meeting with Sims on July 18, 2018. The Revised Draft ERA, submitted herein as Appendix B of the Draft SRP, took into consideration comments provided by EPA during that meeting. The Revised Draft ERA evaluated both baseline risk associated with current site conditions, as well as residual risk associated with site conditions assuming the implementation of the preferred alternatives identified in the Draft SRP.

The ERA concluded that potential risk to ecological receptors that may use the Project Area as habitat, both under baseline and post-remediation conditions, is negligible. The baseline ERA, using accepted EPA protocols, risk criteria, and relevant precedents, predicted that representative wildlife populations have probable risk estimates well below levels that would result in unacceptable risk, even using a very conservative site use factor of 0.5.

Residual risk estimates also showed that representative wildlife populations have probable risk estimates well below levels that would result in unacceptable risk. The residual risk estimates were overall lower than the baseline risk estimates.

Closing

If you have any questions, please contact Peter Zawislanski at peter.zawislanski@terraphase.com or 510-645-1858.

For Terraphase Engineering Inc.

Peter Zawislanski, PG, CHG
Principal Hydrogeologist

Jeff Wallace, PG
Principal Geologist

cc: Rich Campbell, EPA
Vispi Patel, Sims Metal Management
Scott Miller, Esq., Sims Metal Management
Margaret Rosegay, Esq., Pillsbury Winthrop Shaw Pittman
Lisa Saban, Windward Environmental LLC

Enclosures: *Draft Sediment Remediation Plan*, Terraphase Engineering Inc., October 16, 2018
Revised Draft Ecological Risk Assessment, Windward Environmental LLC, October 16, 2018

DRAFT
SEDIMENT REMEDIATION PLAN SIMS METAL MANAGEMENT REDWOOD CITY, CALIFORNIA

Prepared for

Sims Group USA Corporation
699 Seaport Boulevard
Redwood City, California 94063

Prepared by

Terraphase Engineering Inc.
1404 Franklin Street, Suite 600
Oakland, California 94612

October 16, 2018

Project Number 0012.001.014

terraphase engineering

THIS PAGE LEFT INTENTIONALLY BLANK

CONTENTS

TABLES

FIGURES

APPENDICES

THIS PAGE LEFT INTENTIONALLY BLANK

ACRONYMS AND ABBREVIATIONS

ABM	articulated block mat
BCDC	Bay Conservation and Development Commission
BMPs	best management practices
COCs	constituents of concern
the Consent Decree	Consent Decree between the United States Environmental Protection Agency and Sims Group USA Corporation, Case 3:14-cv-04209, effective December 1, 2014
the Conveyor	Sims's ship-loading conveyor located between the Facility and the Wharf
CSM	conceptual site model
Design Report	Design Criteria Report
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
the Facility	the metal recycling facility operated by Sims at 699 Seaport Boulevard, located within the property leased to Sims by the Port of Redwood City, San Mateo County, California
ft bss	feet below sediment surface
GHG	greenhouse gas
HASP	Health and Safety Plan
JARPA	Joint Aquatic Resource Permit Application
MHWL	mean high water level
NOAA Fisheries	National Oceanographic and Atmospheric Administration Fisheries Division
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PES	PES Environmental, Inc.
the Port	Port of Redwood City
the primary area	the area 50 feet to either side of the Conveyor, between the mean high tide line and Wharf 3
QAP	Quality Assurance Plan
QC	quality control

RAO	remedial action objective
Sims	Sims Group USA Corporation
SRP	Sediment Remediation Plan
SSAP	the Sediment Sampling and Analysis Plan, upon the results of which this SRP is based
SUF	site use factor
Terraphase	Terraphase Engineering Inc.
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
Water Board	San Francisco Regional Water Quality Control Board
the Wharf	Wharf 3 located on Port property adjacent to Redwood Creek on the western side of Herkner Road, used by Sims to dock vessels and for loading recyclable metal into those vessels for export, as a non-exclusive use of that wharf
Windward	Windward Environmental LLC

CERTIFICATION

Information, conclusions, and recommendations in this document have been prepared by a California Professional Geologist.

DRAFT

October 16, 2018

Peter T. Zawislanski — Date
Principal Hydrogeologist
Professional Geologist (CA 7210)
Certified Hydrogeologist (CA 925)

DRAFT

October 16, 2018

Jeff Wallace — Date
Principal Geologist
Registered Geologist (OR G1288)

THIS PAGE LEFT INTENTIONALLY BLANK

SUBMITTAL CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: ____

Name: ____

Title: ____

Date: ____

THIS PAGE LEFT INTENTIONALLY BLANK

1.0 INTRODUCTION

1.1 Purpose

Terraphase Engineering Inc. (Terraphase) prepared and implemented a Sediment Sampling and Analysis Plan (SSAP) in accordance with Paragraph 12 of the September 2014 Consent Decree between the United States Environmental Protection Agency (EPA) and Sims Group USA Corporation (Sims) to characterize the marine sediment within the Project Area, and to determine if the area underneath and proximate to Sims's ship-loading Conveyor located along the centerline of the Project Area has been impacted by total metals and polychlorinated biphenyls (PCBs) associated with the Sims scrap metal ship-loading activities.

In accordance with Paragraph 18 of the Consent Decree, insofar as the SSAP sediment characterization work indicated that the Sims ship-loading operations may have resulted in sediment concentrations of metals or PCBs that exceeded the higher of background concentrations or any applicable sediment quality standard, on a statistically significant basis, Terraphase, on behalf of Sims, hereby timely submits for EPA's review and approval this Draft Sediment Remediation Plan (SRP), which describes how Sims intends to remediate sediment as needed within the Project Area.

In accordance with Paragraph 19 of the Consent Decree, this SRP includes an evaluation of various alternatives for such remediation and a consideration of the potential environmental impacts associated with disturbance of the sediment that may result from one or more of such remedial alternatives. Also in accordance with Paragraph 19, the consideration of such potential environmental impacts is based on the results of an ecological risk assessment (ERA) performed as part of, and presented with, this SRP. Insofar as the SSAP did not identify scrap metal pieces other than bits *de minimis* both in size and quantity in the Project Area, this SRP does not contain an evaluation of alternatives for recycling or disposal of scrap metal.

This SRP also contains a schedule and estimated timetable for obtaining all federal, state, and local permits required for the SRP.

The objectives of the Draft SRP are:

- Establish remedial action objectives,
- Establish remedial action areas,
- Identify appropriate remedial technologies,
- Develop remedial alternatives,
- Evaluate remedial alternatives,
- Select a recommended remedial alternative(s) based on the results of the alternatives evaluation,

- Develop a tentative schedule for implementing the remedy.

1.2 Organization of this Document

This SRP is organized into the following sections.

Section 1.0 provides background information about the Facility, including location, operations, and an overview of the sediment investigation.

Section 2.0 summarizes results from sediment investigations performed in accordance with the SSAP prepared, approved, and implemented in accordance with the Consent Decree.

Section 3.0 summarizes the results of the ERA.

Section 4.0 describes remedial action objectives (RAOs), including details about areas that may require remediation and results of the investigations.

Section 5.0 provides the process for the selection of remedial areas and describes those areas.

Section 6.0 describes Project-Area conditions and constraints which will impact design considerations.

Section 7.0 identifies and compares remedial alternatives in the Riprap Area.

Section 8.0 identifies and compares remedial alternatives in the Subtidal Area.

Section 9.0 describes the preparation and planning for the remedial action plan.

Section 10.0 summarizes the preliminary schedule and coordination required to complete the project.

Section 11.0 reviews the health and safety considerations to complete the remediation plan proposed.

Section 12.0 provides references used to develop this sediment remediation plan.

1.3 Facility Description

Sims operates its metal recycling Facility on property it leases from the Port immediately to the west of Seaport Boulevard. The general location of the Facility is shown on Figure 1. Activities include receiving, stockpiling, handling and shredding and other processing of recyclable (or scrap) metal materials, and storing or stockpiling, loading, and shipping of bulk recyclable metal commodities resulting from such processing.

These activities (excluding ship-loading) occur on an approximately 13.5-acre parcel of land located east of a public right-of-way at the Port known as Herkner Road. The areas to the north and south of the Facility are occupied by a variety of other industrial tenants of the Port.

Sims conducts its ship-loading activities at the Wharf (on a non-exclusive use basis), along the bank of Redwood Creek shipping channel. Sims operates its Conveyor to deliver its specification-grade recyclable steel commodities into the hulls of ships berthed at the Wharf.

Other unrelated bulk cargo operations also conduct industrial ship-unloading activities at the Wharf as well as at other Port-owned or private wharves also located along the bank of Redwood Creek shipping channel on the western side of Herkner Road. These include operations which unload bauxite, gypsum, and miscellaneous construction materials from ships docked at the Port. Other Port tenants use Wharf 3 (but not the Conveyor) for unloading bulk bauxite and gypsum. Port facilities along the water include several ship-loading wharves, docks, and piers along the eastern shoreline of Redwood Creek.

The initial portion of the Conveyor is located on the Facility, but the remainder of the Conveyor spans Herkner Road and a concrete pier and apron located on pilings above the edge of Redwood Creek. The concrete apron is located directly beneath the Conveyor and extends from the shoreline to the edge of Wharf 3. The primary purpose of the apron is to catch material that may fall from the Conveyor during ship-loading operations. The concrete apron was installed in 1991 and was improved in 2002 to include additional screening material along the sides.

1.4 Project Area

The Project Area along the edge of a small portion of Redwood Creek is centered around the Sims Conveyor at Wharf 3, as shown on Figure 2. The Project Area was selected in conformance with the sampling protocol presented in the Consent Decree, which required investigation of "the area 50 feet to either side of the Conveyor, between the mean high tide line and Wharf 3" ("the primary area"). The Project Area was expanded to the north and south, i.e., away from the Conveyor, based on investigation findings.

The Project Area includes a subtidal portion, which extends from Wharf 3 to the base of the riprap, and an intertidal portion, which extends from the base of the riprap to the mean high water level (MHWL).

2.0 INVESTIGATION UNDER THE CONSENT DECREE

2.1 Overview

In accordance with the SSAP, the area of the sediment investigation was on either side of the Conveyor, between the MHWL and Wharf 3. The sediment investigation was conducted in two phases (June 2016 and March 2017) in accordance with the EPA-approved *Final Sediment Sampling and Analysis Plan and Quality Assurance Project Plan* (Terraphase 2016). The findings of the sediment investigation are presented in the *Final Sediment Investigation Report*, dated March 1, 2018 (Terraphase 2018).

Sediment samples were collected throughout the Project Area and in three background areas (Wharves 2, 4, and 5). Project-Area subtidal and riprap sediment sample locations are shown on Figure 3.

Surficial and subsurface samples were collected from up to 5 feet below sediment surface (ft bss) in the subtidal area. Surficial samples were collected from the intertidal zone along the riprap-armored shoreline. In total, 184 discrete sediment samples were submitted for chemical analysis for 19 individual metals and PCB Aroclors. The resulting data set was statistically evaluated to develop site-specific background concentrations for the analytes, and to compare Project-Area analytical results with background concentrations. The number and distribution of sample locations in the Project Area were sufficient to characterize the extent of metals and PCBs in accordance with the Consent Decree, and to assess any associated environmental risk.

The analytical data, in conjunction with the field observations, demonstrated that metals and PCB concentrations in excess of designated background levels were generally limited to shallow sediments in the primary area, i.e., within approximately 50 feet on either side of the Conveyor.

2.2 Sediment Observations

Based on visual-manual characterization, the sediment in the Project Area consists predominantly of silt and clay, with minor amounts of sand and gravel. Trace amounts of shell fragments were commonly observed in the surficial and shallow-depth core samples. The sediment was generally homogeneous in nature, with relatively uniform coloration, grain-size distribution, and consistency. The majority of sediments encountered were dark gray to black, silt to clayey silt, soft to medium stiff, wet to saturated, and moderately plastic. No significant stratification (i.e., sand lenses or other natural lithologic boundaries) was noted during coring activities.

2.3 Recyclable (Scrap) Metal

The presence of scrap metal in the sediment samples was visually evaluated in the field during sample processing (i.e., sieving). Bits of scrap metal were observed in sediment from 18 out of 58 locations sampled in the Project Area. Scrap metal included bits of wire and miscellaneous metal hardware (screws, nails, washers). Most of the locations where scrap metal was observed were limited to an area within 50 feet of the concrete apron. Identified metal fragments were generally quite small (mainly wire), with a few fragments up to 2 inches in maximum dimension, which were sparsely distributed through the upper section of the sediment cores.

2.4 Vibracore Penetration Observations

An increase in sediment density was noted based on the vibracore penetration rate in the area near the concrete apron; however, no material that can be interpreted to consist of an indurated metal mass was observed. At seven coring locations (W3-5, W3-6, W3-7, W3-41, W3-43, W3-44, and W3-47), at approximately 1.5 to 2 ft bss, a semi-consolidated interval was encountered during vibracore advancement which slowed the penetration rate. The driller was able to advance the vibracore to the targeted sample depth at all of these locations, except for location W3-43, where refusal was encountered three times at a maximum depth of 3 feet. Based on visual examination of the sediment cores, the interval corresponding to this relatively denser interval consisted of gravel-sized particles with trace amounts of non-native materials, such as synthetic fiber, and bits of wire and other metal fragments. These materials formed a dense, weakly agglomerated, friable mass that could be disarticulated under finger pressure. The material was degraded and corroded. No evidence of an agglomerated metal mass was observed or evidenced by the drilling action of the vibracore, or the observations of recovered sediment cores.

2.5 Summary of Findings

The following sections summarize the findings of the sediment investigation, with a focus on the spatial distribution of metals and PCBs. Detailed investigation findings are presented in the *Final Sediment Investigation Report* (Terraphase 2018). Statistical summary tables of metals and PCB concentrations are presented in Appendix A.

2.5.1 Spatial Distribution of Metals in the Project Area

Concentrations of metals in the Project Area were highest in subtidal sediment near the concrete apron and along the intertidal riprap shoreline on either side of the concrete apron. Concentrations of metals in subtidal sediment generally decreased with distance from the concrete apron, both to the south and north. The highest metals concentrations were found in the 1.5-to-2-foot depth interval, with decreasing concentration trends to total depth (up to 5.0 ft bss), and lower concentrations immediately below the sediment surface (0-to-0.5-foot depth interval). Metals concentrations were generally higher at core locations near the apron than at distal core locations. Riprap samples collected from the Project Area exhibited overall higher concentrations of metals than subtidal samples in the Project Area. A similar trend was observed in the background areas.

2.5.2 Spatial Distribution of PCBs in the Project Area

Similar to metals, concentrations of PCBs in the Project Area were highest in subtidal sediment near the concrete apron and along the intertidal riprap shoreline on either side of the concrete apron. Concentrations of PCBs in subtidal sediment generally decreased with distance from the concrete apron, both to the south and north. Riprap samples in the Project Area exhibited overall higher concentrations of PCBs than subtidal samples in the Project Area, which is consistent with the trend observed in background areas.

Of the 18 cores advanced in the Project Area, all, except one, were advanced to at least the target depth of 5 ft bss. Of the 17 samples analyzed from 5 ft bss – the maximum depth from which analytical data were obtained – six samples contained total PCBs below the method reporting limit for PCBs. Overall, the core sample data clearly indicated a decreasing PCB concentration trend with depth.

The vertical distribution of total PCBs in core samples indicated that the highest PCB concentrations were in the 1.5-to-2-foot depth interval, with decreasing concentrations to total depth, and lower concentrations near the sediment surface. Total PCB concentrations were higher in subsurface sediment at locations near the apron than in distal core locations (i.e., at locations more than 50 feet from the Conveyor).

2.5.3 Discussion

Concentrations of metals and PCBs in Project-Area sediments were found to generally decrease with distance from the concrete apron and with increasing depth below 2 ft bss. The observed concentration trends indicated that the lateral distribution of metals and PCBs in subtidal sediments was adequately characterized in the Project Area.

Concentrations of both metals and PCBs in Project Area core samples were almost uniformly highest in the 1.5-to-2.0 ft bss depth interval. Concentrations of metals and PCBs decreased significantly with depth below 2 ft bss.

To assist in evaluation of remedial alternatives, the sample locations were assigned to Thiessen polygons, as shown on Figure 4. The constituent data associated with the sample(s) collected at the sample locations were used to evaluate risk associated with each polygon (Appendix A).

3.0 SUMMARY OF ECOLOGICAL RISK ASSESSMENT

On behalf of Sims, Windward Environmental LLC (Windward) prepared an ERA for the Project Area in accordance with applicable risk assessment guidance and policies (EPA 1997, 1998; California DTSC 1996). The ERA is presented in Appendix B. The ERA took into consideration comments provided by EPA during a meeting with Sims on July 18, 2018.

The ERA was developed for baseline and residual conditions, assuming remediation of sampling locations with the highest concentrations of constituents of concern (COCs), as identified by EPA, and as memorialized in the EPA letter dated August 23, 2018 (Appendix C). The ERA approach and findings are summarized below.

3.1 Goals and Approach

The goals of the ERA were to:

- Develop an ecological conceptual site model (CSM) of the riprap and subtidal areas;
- Evaluate the potential for exposure of ecological receptors to COCs under baseline conditions and under conditions that would exist upon implementation of the remedial alternatives described in this SRP;
- Compare the potential exposure to effects thresholds to characterize potential risks; and
- Use, to the extent possible, ERA analyses similar to those used in the San Francisco Bay area as a basis for assumptions and receptors.

For purposes of the ERA, the Project Area was divided into two exposure evaluation units: (1) the riprap unit (lower and upper riprap), and (2) the lower riprap/subtidal unit, described as follows:

- The riprap unit is covered by large rocks, which limit physical access to the underlying sediments. The lower portion of the riprap covered slope has rock covering that is less dense (with more exposed sediment) than in the uppermost riprap area.
- The lower riprap/subtidal unit consists of the lower portion of the riprap-covered slope and the subtidal sediment.

The differentiating characteristic between the two units is how accessible they are to potential foraging wildlife receptors; consequently, the two units were considered separately.

The ecological CSM identified potential ecological receptors and potential ecological exposure pathways. The selected ecological receptors included benthic invertebrates and wildlife. The lesser scaup and great blue heron bird species were identified as representative benthic-invertebrate-eating, site-specific wildlife receptors for the subtidal/lower riprap area and the upper riprap area, respectively. Fish-eating birds were not considered in the ERA because fish are exposed to sediment over a much larger region than the Project Area, and the foraging range of fish-eating birds is much greater than that of invertebrate-eating birds.

The ERA used Project-Area metals and PCB concentrations from the final *Sediment Investigation Report* (Terraphase 2018) to calculate exposure point concentrations. Risk calculations were based on conservative assumptions, including low-effect thresholds and a high site use factor (SUF) of 0.5. An SUF of 0.5 means that the wildlife receptors are assumed to forage in the Project Area 50% of the time. This is very conservative given the very small size of the Project Area (0.6 acre) relative to the surrounding habitat (239 acres).

The ERA calculated risk due to current conditions (baseline ERA), and due to conditions following remedial action that would address the highest concentrations of metals, as identified by the EPA (residual ERA). The residual risk calculations assumed dredging/removing sediment with the highest metals concentrations in the subtidal area and capping sediment with the highest metals concentrations in the riprap area.

3.2 Findings

The potential risk to aquatic birds that may use the Project Area was determined to be negligible based on the risk characterization results for baseline conditions. The baseline ERA predicted that maximally exposed representative wildlife populations have probable risk estimates well below levels that would result in unacceptable risk. Exposure is limited, and even given conservative assumptions in the risk assessment, there is little likelihood of unacceptable risk in the Project Area.

Residual risk estimates also showed that representative wildlife populations have probable risk estimates well below levels that would result in unacceptable risk. The residual risk estimates were overall lower than the baseline risk estimates. Notably, the residual risk due to lead was one half of the baseline risk in both the subtidal and riprap areas.

The ERA concluded that there is a low probability of unacceptable risk to the benthic community from COCs in the Project Area for both baseline and residual conditions, based on Project Area baseline and residual chemistry data, risk analyses of nearby benthic toxicity and community, and the lack of causative toxicity from COCs found in the Project Area.

4.0 REMEDIAL ACTION OBJECTIVES

The Project Area has been characterized and is sufficiently understood to support an evaluation of technology alternatives and selection of recommended remediation strategies. The extent of Project-Area impact is based on data discussed in Section 2 and presented in detail in the *Final Sediment Investigation Report* (Terraphase 2018).

RAOs provide a general description of what the remediation will accomplish. Three RAOs have been identified for the Project Area, as follows:

- RAO-1: Eliminate receptor exposure to sediments with highest COC concentrations in sediments.
- RAO-2: Reduce the potential for migration of COCs from the riprap area to the subtidal area due to tidal and wave processes.
- RAO-3: Support green remediation initiatives, in particular by minimizing energy use and the volume of generated waste.

4.1 Remedial Action Objective 1

The investigations discussed in Section 2 characterized COC concentrations in sediments. The EPA identified sediment "hot spots", as defined by the highest concentrations of metals, in the subtidal area. RAO-1 can be achieved by either removing the hot-spot sediments (using excavation or dredging), or by capping. Achieving RAO-1 will also reduce risk to aquatic receptors, as shown by the ERA (Section 3; Appendix B).

4.2 Remedial Action Objective 2

The riprap is inundated twice daily by the tidal cycle. Impacted sediment, while generally protected between riprap blocks, may erode due to tidal and wave action and be transported to the subtidal zone, where ecological receptors may be exposed. RAO-2 can be achieved by immobilizing the sediment in riprap hot spots.

4.3 Remedial Action Objective 3

Green remediation solutions are identified to embed sustainability into project planning and outcomes to reduce energy use, waste, and air emissions, including greenhouse gases (GHGs) during investigation and cleanup. The core elements of green remediation include site-specific best management practices (BMPs) for inclusion in design, and recommended practices with the following goals:

- Reduce total energy use and increasing energy use from renewable sources;
- Reduce air pollutants and GHGs;
- Reduce water use;
- Improve materials management and reduce waste; and
- Protect ecosystem during cleanup.

The SRP has been developed to only implement activities required to achieve RAOs 1 and 2, thereby minimizing unnecessary energy usage, waste generation, and short-term exposure to ecological receptors.

5.0 REMEDIAL ACTION AREAS

Sediment hot spots were defined as remedial action areas based on the results of the sediment investigations (Terraphase 2018), discussions with EPA staff (July 18, 2018), and the EPA letter dated August 23, 2018 (Appendix C). The lateral extent and depth of the remedial action areas is discussed below for the riprap remedial action area (the Riprap Area) and the subtidal remedial action area (the Subtidal Area).

5.1 Riprap Area

The Riprap Area remedial action area is defined by the Thiessen polygons ascribed to sample locations W3-12, W3-14, W3-15, W3-22, W3-23, W3-24, W3-25, and W3-27, as shown on Figure 5. These polygons were selected based on the highest metals concentrations in sediment at the given sample location, as defined by the EPA (Appendix C). The northernmost polygon (W3-25) is truncated at the edge of the vehicle access ramp because the ramp presents substantial constructability issues, and metals and PCBs concentrations are fairly low at sample location W3-25. The estimated area of the Riprap Area is shown on Table 1.

5.2 Subtidal Area

The Subtidal Area is defined by the Thiessen polygons ascribed to sample locations W3-06, W3-07, W3-08, W3-41, W3-43, and W3-48, as shown on Figure 7. Similar to the Riprap Area, these polygons were selected based on the highest metals concentrations in sediment at the given sample location, as defined by the EPA (Appendix C). The estimated area of the Subtidal Area is shown on Table 2. The total remedial depth is 2 ft bss, consistent with the depth of the highest concentrations of metals in sediment.

6.0 CONDITIONS AFFECTING DESIGN CRITERIA

6.1 Structures, Access, and Constraints

The Project Area is located in Redwood Creek and is centered around the Sims Conveyor at Wharf 3. The Redwood Creek channel is a federally funded navigation area that is dredged periodically by the United States Army Corps of Engineers (USACE) and is maintained at -30 feet mean lower low water.

Wharf 3 was designed to allow for cargo vessel access, mooring, and loading/unloading, predominantly of recyclable (scrap) metal and dry bulk cargo. It consists of a concrete deck supported by plumb and battered prestressed concrete piles. The deck consists of concrete pile cap girders running transversely to the wharf at 20-foot spacings. The pile cap supports prestressed deck plank sections topped with a cast-in-place concrete slab.

A concrete ramp that provides vehicle access from Herkner Road to Wharf 3 is located approximately 60 feet north of the apron. The Project Area extends north beyond the vehicle ramp by approximately 40 feet. The southern boundary of the Project Area is defined by a conveyor used by a business unrelated to Sims to transload gypsum to marine vessels.

Collectively, the Wharf, the apron, and the vehicle ramp present significant barriers to access of the Project Area from Redwood Creek. Small, narrow-beam vessels, with limited superstructure and low freeboard, can transit under the Wharf during low tidal stage. Tidal fluctuation at the Project Area is typically 6 feet to 8 feet.

A photo log illustrating the access constraints of the Project Area is provided in Appendix D.

6.2 Subtidal Area

Project-Area characteristics, field observations, and studies conducted in Redwood Creek by others all indicate that the Subtidal Area is in a low-energy environment, where sediment deposition dominates over sediment erosion. Accordingly, deeper sediment would be expected to remain buried, preventing ecological receptors exposure to COCs. Information suggesting that the sedimentation processes are primarily depositional includes:

- The impacted area is tightly constrained by the piles supporting the Wharf and other over-water structures. Collectively, the piles would be expected to decrease tidal current velocities, creating a low-energy environment conducive to sediment deposition.
- No vessel traffic occurs shoreward of the Wharf, limiting the potential for sediment erosion from vessel propwash scour.
- Redwood Creek is a depositional environment. The navigation channel has required dredging every two years since 1965 (HydroPlan 2015). The average annual volume of sediment deposited in the Redwood Creek Harbor Channel is approximately 5 million cubic feet. Given an area of approximately 8.8 million square feet, the average sedimentation rate is over 6 inches per year (HydroPlan 2015).

- In 1995, Sims removed approximately 245 cubic yards of metals-impacted sediment from the Project Area (PES 1996). The subtidal sediment was hydraulically dredged down to a hardpan surface that was determined to be the practical limit of removal. The results of the recent investigation indicate that the area dredged in 1995 appears to be now uniformly covered with soft surficial sediment predominantly composed of fine-grained particles. This indicates that in the past two decades, the area has been depositional.

As discussed in Section 2.5.3, concentrations of metals and PCBs in the subtidal sediment were typically highest in the 1.5-to-2.0 ft bss depth interval. Sediment at this depth is below the bioactive zone and will remain so unless exposed by erosion.

Bathymetric data for the Project Area are not currently available. However, based on sounding observations during the sediment sample collection, it appears that the seabed may slope steeply from the area shoreward of the wharf to the berthing area. A bathymetric survey will be conducted to ensure that the proposed remedy will adequately address this potential site condition to be evaluated during the design.

6.3 Riprap Area

Field observations in the Riprap Area show little evidence of erosion as large riprap is placed along the shoreline to prevent sediment mobilization. It appears that the riprap has been an effective erosion control feature. There is some erosion potential as a result of wave action from boat traffic and tidal action; however, that is only anticipated to occur around and below the MHWL, which is covered with riprap.

The Riprap Area is accessible by Herkner Road along the shoreline. Access to the Riprap Area may require specialized equipment to place materials onto the slope from the road, such as a crane, pneumatic pumping equipment, or other delivery device.

7.0 REMEDIAL ACTION ALTERNATIVE EVALUATION - RIPRAP AREA

Remedial response action technologies identified for the Riprap Area are described and screened below. Based on the screening, three alternatives were selected for comparative evaluation. A preferred remedial alternative is selected.

7.1 Technology Screening

Potential remedial technologies identified for the Riprap Area are described below and summarized in Table 3.

7.1.1 No Action

Under a No Action scenario, there would be no implementation of engineering or institutional controls, impacted sediments would remain in place, and no treatment would be implemented. Although No Action does not involve physical remediation, some reduction of the impacted sediment mass may occur over time via natural attenuation processes. However, the COCs are relatively persistent, so natural attenuation processes would take a considerable amount of time.

The advantages of the No Action scenario are:

- There would be no disruption to ongoing industrial activities in and near the Project Area.
- There would be no disturbance of sediments, which can lead to sediment re-suspension.
- There would be no costs.

No Action would not meet the RAOs. No Action will be retained as a remedial action alternative solely to provide comparison as a baseline condition.

7.1.2 Institutional Controls

Institutional controls are administrative or legal controls, such as fish consumption advisories, waterway use restrictions, site access restrictions, or environmental easements that can be implemented to minimize impacts. Institutional controls can reduce exposure to humans and aquatic receptors and may be combined with other technologies to improve the effectiveness of the selected remedies. One example of an institutional control may be to implement a long-term monitoring and maintenance program.

Institutional controls can be effective at reducing exposure to COCs and are most successful when used in combination with other remedial technologies. Institutional controls alone would not reduce pathways to aquatic receptors in the short-term. Natural attenuation as a means for sediment remediation is not likely to be stimulated by the implementation of institutional controls more than it would be by No Action. As a result, institutional controls may be required during the design process as a result of the chosen remedy, but will not be evaluated further as a remedial action technology.

7.1.3 Excavation

Excavation, as a remedial technology in the Riprap Area, would consist of removing the existing riprap, removing the underlying sediment, and reconstructing the riprap armor surface cover. Under this scenario, the riprap blocks and underlying sediment would be removed and disposed of offsite. There is limited data on the extent of metals and PCBs in subsurface sediment within the Riprap Area. Therefore, the targeted depth of sediment removal would need to be established, either through excavation or selecting the thickness of a bioactive layer (e.g., 10 centimeters) to promote a bioactive zone capable of attenuating the COCs that may remain at undetermined depths.

Excavation could be conducted, to a large extent, using a land-based excavator. However, using a land-based excavator to remove portions of the Riprap Area under the low-clearance apron and vehicle ramp would be impractical. The process of excavation would expose materials that would otherwise not be mobilized. Excavated riprap and sediment could be loaded into trucks, and it is possible that the riprap blocks could be cleaned and recycled, or transported to an offsite landfill.

Dewatering/stabilization of the sediment would be necessary during excavation and prior to transporting for disposal. If free liquids are produced by the sediment processing, then water containment and water treatment/discharge or transportation/disposal would be needed as well.

Reconstruction of the riprap shoreline area would consist of the placement of clean soil and riprap blocks to match the current site conditions. The excavation scenario would disturb sediment below the MHWL and would likely take at least four weeks to complete, due to short work windows to allow the excavation to be completed in dry conditions (i.e., at low tide). At each high tide cycle, the work area would be inundated. Exposed impacted sediment below the water level could be resuspended into the water column. Silt curtains or other method of sediment control would be needed to control the potential release of impacted sediment outside the remedial action area. Due to the increased risk to aquatic receptors during excavation, in addition to the high energy and water use, excavation will not be evaluated further as a remedial action technology.

7.1.4 Capping

Capping in the Riprap Area includes three process options: shotcrete, sand/rock cap, and sand cap with articulated block mat (ABM). All containment options would require periodic inspection and maintenance for the foreseeable future to ensure that sediments are not exposed due to inadequate coverage, erosion, or cracking. Institutional controls may be required as well. The process alternatives for containment or capping are discussed below.

Shotcrete: Shotcrete is a quick-drying concrete slurry that can be applied over the surface of the Riprap Area. Shotcrete is a concrete material that is applied using compressed air to shoot the material onto the receiving surface. The high velocity helps consolidate the material. Shotcrete is commonly used and readily available. Shotcrete would isolate the Riprap Area sediments.

Equipment to implement this alternative could potentially be deployed from land, eliminating the difficult access issues present in the waterway between the wharf and the shoreline. Shotcrete requires time to cure before it is submerged by the tidal cycle. Short duration between tidal cycles may not be adequate to allow the concrete to fully cure before getting submerged after installation. It is possible that a quick-curing compound could be added to the shotcrete mix to accelerate curing. However, shotcrete would not adhere to surfaces where mud overlies the blocks and thus would not result in a durable surface. Considerable volume of material may be required to ensure complete coverage of the irregular surface. Concrete is alkaline and may cause release of high-pH slurry to water. Shotcrete would need to be periodically inspected for cracking, and would be repaired, as needed.

The shotcrete containment option will not be evaluated further as a remedial action technology due to uncertainties about implementability in an intertidal environment.

Sand Cap: A sand cap consists of placing sand in between the interstitial spaces of the existing riprap surface to physically isolate the impacted sediments. The sand cap would prevent the potential exposure of environmental receptors to the impacted sediment between riprap blocks, and erosion of sediment due to tidal/wave action.

A sand cap is a standardized technology. Typically, a 1- to 2-foot thickness of sand is adequate to isolate the impacted sediment. Access issues discussed in Section 6, i.e., the low-clearance apron and vehicle ramp, would present logistical challenges. It is possible that sand could be conveyed to the understructure areas using some combination of a belt conveyor, hose/compressed air, and/or manual labor. It is expected that all or most of the work could be implemented from the land.

A sand cap would be more vulnerable to erosion than the current armored surface. It would need to be periodically inspected and replenished, as needed, to remain an effective containment layer.

The sand cap containment option will be retained for further evaluation as a remedial action technology because it would meet the RAOs and is implementable.

Sand Cap with Articulated Block Mat: This containment option is similar to a sand cap, except that it includes an additional ABM armor layer as the final surface. The ABM would be placed over the sand cap to improve the durability of the sand cap against tidal and wave erosion, and thus mimic the armoring function of the current riprap surface. Prior to placement of the ABM, the base sand layer would be flattened and compacted. A geotextile fabric may need to be incorporated into the cap design.

Similar to the sand cap, this containment option prevents potential exposure of environmental receptors to the impacted sediment and would prevent erosion of sediment. However, maintenance requirements are lower compared to a sand cap alone.

During the design work, the feasibility of installing the ABM under structures would need to be evaluated. If use of ABM is not possible in some areas, a gravel layer may be a substantially similar substitute. This alternative will conflict with the no net fill policy; mitigation measures may be required.

The sand cap and ABM containment option will be retained for further evaluation as a remedial action alternative because it would meet the RAOs and is implementable.

7.2 Evaluation of Riprap Area Remedial Alternatives

Three technologies for the Riprap Area were retained as remedial action alternatives for comparative evaluation. The following criteria were considered in evaluating the remedial alternatives:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

The alternatives evaluation is discussed below. A summary of the evaluation and ranking of remedial action alternatives is presented in Table 4.

7.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the restoration time frame, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to maintain effectiveness. Given the lack of unacceptable risk posed by the COCs, as determined by the ERA, the primary objectives of conducting remedial action in the Riprap Area is to eliminate exposure of potential receptors to sediment hot spots, and to minimize the potential for downslope transport of hot-spot sediments into the subtidal zone.

- *Alternative 1 (No Action)* – This alternative would not be effective because metals do not degrade over time and PCBs are persistent chemicals that degrade very slowly. Due to tidal cycling, prop wash, and wave energy, erosion may mobilize sediments over time and release them into the subtidal portions of Redwood Creek.

- *Alternative 2 (Sand Cap)* – This alternative would be effective over time and permanently isolate the affected sediment; however, without an armor layer, more frequent maintenance (i.e., replenishment of the sand cover) would likely be required. The need for maintenance could be easily monitored by periodic visual inspection.

- *Alternative 3 (Sand Cap with ABM)* – This alternative would be effective over time and permanently isolate the affected sediment; including ABM will reduce maintenance frequency relative to the sand cap alone.

Alternative 3 has the highest long-term effectiveness, followed closely by Alternative 2. Alternative 1 is least effective.

7.2.2 Reduction of Toxicity, Mobility, or Volume

This criterion assesses the ability of the alternatives to reduce the toxicity, mobility, or volume.

- *Alternative 1 (No Action)* – This alternative does not reduce the toxicity, mobility, or volume of the affected sediment.
- *Alternative 2 (Sand Cap)* – This alternative would be effective at reducing the mobility of the affected sediment by isolating it from erosive forces that could transport the material downslope over time.
- *Alternative 3 (Sand Cap with ABM)* – This alternative would be effective at reducing the mobility of the affected sediment by isolating it from erosive forces that could transport the material downslope over time.

Alternatives 2 and 3 provide a similar level of mobility reduction. Alternative 1 does not reduce mobility.

7.2.3 Short-Term Effectiveness

Management of short-term risks is the degree to which human health and the environment are protected during implementation of the alternative.

- *Alternative 1 (No Action)* – Because no work would be done, there are no short-term risks posed by the action.
- *Alternative 2 (Sand Cap)* – This alternative would require workers to traverse the irregular riprap surface where slip/trip accidents may occur, causing injury. Because an initial layer of sand would be placed prior to requiring ground work (shoveling and mechanically vibrating the sand into the interstitial spaces between riprap blocks), the human health exposure to COCs would be minimal. Working under structures would pose additional physical hazards. There would be negligible disturbance to the sediment underlying the riprap.
- *Alternative 3 (Sand Cap with ABM)* – Similar to Alternative 2, risks to human health and the environment would be minimal. The placement of the ABM would pose overhead risk as the mats are moved into place.

Alternative 1 has the highest short-term effectiveness. Alternatives 2 and 3 have similar short-term effectiveness.

7.2.4 Implementability

Implementability is the relative difficulty of implementing a given remedial action. Evaluation of implementability includes consideration of technical factors, such as the availability of mature technologies and experience of contractors to accomplish the cleanup work. It also includes administrative factors associated with permitting and completing the remedial action.

- *Alternative 1 (No Action)* – Because no work would be done, the implementability factor is limited to the ability to gain acceptance of the alternative from regulatory agencies and property owner, the Port of Redwood City.
- *Alternative 2 (Sand Cap)* – This alternative would be readily implementable for most of the remedial action area. The sand would be mechanically placed over the riprap blocks to stabilize and isolate the sediment. Much of the area could be worked from the land side using a long-arm excavator. Under the conveyor apron and the vehicle ramp, workers on the shoreline could place sand in limited-access areas.
- *Alternative 3 (Sand Cap with ABM)* – Similar to Alternative 2 with respect to the sand placement. Installation of ABM is unlikely to be practical under structures. This alternative may result in net fill to the Bay, which may pose permitting challenges.

Alternative 1 is the most implementable from a technical perspective, but least implementable based on administrative factors. Alternative 2 is more implementable than Alternative 3.

7.2.5 Cost

Cost factors associated with completing the remedial action include design, permitting, labor, materials, equipment, disposal, long-term monitoring and maintenance, and, potentially, mitigation.

- Alternative 1 (No Action) – There would be no cost because no work would be done.
- Alternative 2 (Sand Cap) – The major costs for this alternative include permitting, labor, materials, and equipment.
- Alternative 3 (Sand Cap with ABM) – The costs factors would be similar to Alternative 2, except for (1) significant additional material and placement costs for ABM, (2) higher permitting costs, and (3) potential mitigation costs.

Alternative 1 has the lowest cost, followed by Alternative 2, and then Alternative 3, which has the highest cost.

7.3 Preferred Alternative for the Riprap Area

The results of the comparative evaluation are summarized in Table 4.

Based on the scoring and ranking of the alternative in accordance with the screening criteria above, Alternative 2 is selected as the preferred alternative for the Riprap Area.

- Alternative 1 (No Action) does not meet RAOs.
- Alternative 2 (Sand Cap) is the recommended alternative. Alternative 2 will meet the RAOs because it will eliminate potential receptor exposure to hot-spot sediments, thereby reducing risk, and will prevent erosion of hot-spot sediment and its potential transport to

the Subtidal Area. An operations and maintenance plan will likely be required, and will include criteria for the periodic replenishment of the sand cap.

- Alternative 3 (Sand Cap with ABM) would also meet RAOs, but its cost is higher and implementability lower than Alternative 2 due to the challenges associated with placing ABM under structures and due to additional permitting issues. The additional armoring does not reduce sediment mobility relative to Alternative 2.

8.0 REMEDIAL ACTION ALTERNATIVE EVALUATION - SUBTIDAL AREA

Remedial response actions technologies identified for the Subtidal Area are described and screened below. Based on the screening, three alternatives were selected for comparative evaluation. A preferred remedial alternative is selected.

8.1 Technology Screening

Potential remedial technologies identified for the Subtidal Area are described below and in Table 5.

8.1.1 No Action

Under the No Action scenario, there would be no implementation of engineering or institutional controls, impacted sediments would remain in place, and no treatment would be implemented. Although no action does not involve physical remediation, some reduction of the impacted sediment mass may occur over time via natural attenuation processes. However, the COCs are relatively persistent, so natural attenuation processes would take a considerable amount of time. However, over the long term, sedimentation is likely to cut off the pathway between the sediments and aquatic receptors.

The advantages of the No Action scenario are:

- There would be no disruption to ongoing industrial activities in and near the Project Area.
- There would be no disturbance of sediments, which can lead to sediment re-suspension.
- There would be no costs.

No Action would not meet the RAOs. No Action will be retained as a remedial action alternative solely to provide comparison as a baseline condition.

8.1.2 Institutional Controls

Institutional controls are administrative or legal controls, such as fish consumption advisories, waterway use restrictions, site access restrictions, or environmental easements that can be implemented to minimize impacts. Institutional controls can reduce exposure to humans and aquatic receptors and may be combined with other technologies to improve the effectiveness of the selected remedies. One example of an institutional control may be to implement a long-term monitoring and maintenance program.

Institutional controls can be effective at reducing exposure to COCs and are most successful when used in combination with other remedial technologies. Institutional controls alone would not be a pragmatic method for reducing pathways to aquatic receptors in the short-term. Natural attenuation as a means for sediment remediation is not likely to be stimulated by the implementation of institutional controls more than it would be by No Action. As a result,

ED_013190_00000126-00035

institutional controls may be required during the design process as a result of the chosen remedy, but will not be evaluated further as a remedial action technology.

8.1.3 Capping

Capping in the Subtidal Area includes two process options: an isolation layer and an armor layer. Capping would require periodic inspection and maintenance, in perpetuity, to ensure that COCs are not being released due to inadequate coverage, erosion, or cracking. Capping designs must be engineered to comply with the no net fill policy. The two process options are discussed below.

An isolation layer is a sediment cap that is engineered to effectively eliminate exposure to aquatic organisms by cutting off direct physical contact of the underlying sediments. Isolation layers are a standardized technology where typically a 1- to 2-foot thickness of the installed sand cap is adequate to isolate the types of COCs present in the subtidal project area. The performance objectives of an isolation layer would be to physically and chemically isolate COCs present, as well as stabilize against erosion. Capping prevents potential exposure to aquatic receptors to COCs present in the sediment.

Installation of the isolation layer in areas not covered by the apron or wharf could be done by using a telebelt truck positioned on the apron or the shoreline. However, specialized equipment would be needed for a water-based delivery system to place capping material under the apron and the wharf. Additional design considerations include bioturbation, consolidation, erosion, bathymetric survey, installation, and operational issues related to the cap's ability to isolate impacted sediment.

Long-term monitoring and maintenance activities are needed to ensure that the cap does not erode. Any fill placed would have to meet the no net fill policy.

Capping was retained for further evaluation as a technology that could be used in conjunction with dredging. Capping alone was not retained because it would result in net fill to the Bay.

8.1.4 Dredging

Dredging is the physical removal of sediment by use of mechanical, hydraulic, or diver-assisted micro-dredging. Applicable dredging techniques are discussed in the following sections.

8.1.4.1 Mechanical Excavation

Mechanical excavation involves the removal of sediment by using earthmoving equipment (e.g., excavator and backhoe). Mechanical excavation can be undertaken in either dry or wet conditions. For dry excavation, the excavation area must first be dewatered. Sheet pile walls are installed to dewater the remedial action area for excavation. For wet excavation, the excavator would directly dig through the water column.

Based on a preliminary site inspection by a dredging contractor, excavation from shore using a long-reach excavator is feasible in areas that are not under the wharf or apron. However, removal of sediments with mechanical excavation is not feasible under the wharf and concrete apron. Mechanical excavation will result in sediment resuspension and turbidity, which increases the short-term exposure to aquatic receptors from contamination that may be present in the sediment and will increase energy use for processing and disposal.

Mechanical excavation is not retained for further evaluation due to implementability issues and sediment resuspension.

8.1.4.2 Mechanical Dredging

Mechanical dredging typically uses a suspended or manipulated bucket to collect sediment and raise it to the surface in a way that minimizes sediment loss and turbidity. The removed sediment can be loaded onto a barge or other vessel for processing and disposal. Relative to mechanical excavation, mechanical dredging reduces the amount of dewatering, sediment processing, and treatment required following sediment removal. Less waste is typically generated. However, restricted access makes mechanical dredging impractical under and around the wharf and concrete aprons.

Mechanical dredging is not retained for further evaluation due to implementability issues.

8.1.4.3 Hydraulic Dredging

Hydraulic dredging uses suction to remove impacted sediments, which are then pumped to the surface through a pipeline for processing and disposal. Typically, hydraulically dredged sediments contain about 10-20% solids, producing a large volume of slurry that must be processed. Although hydraulic dredging is feasible in the Subtidal Area, there are several disadvantages to this method. Locating and mobilizing equipment may be challenging. Hydraulic dredging will produce a higher volume of sediment slurry than mechanical dredging, resulting in additional costs for dewatering and treatment. This method may adversely affect the infrastructure, i.e., the footings for the wharf and apron, because the amount of sediment removed would be hard to control, especially under the structures.

Hydraulic dredging is not retained for further evaluation because it would be difficult to implement and control under structures.

8.1.4.4 Micro-Dredging

Micro-dredging, or diver-assisted dredging, involves a diver or remotely operated vehicle to remove sediment. This method is the best way to preserve critical infrastructure that may be impacted by other removal methods. Micro-dredging is also useful where infrastructures prevent deployment of larger equipment and also has the lowest potential for sediment re-suspension of all the dredging options. If feasible, the dredge material would be pumped directly to an upland dewatering/processing area. Micro-dredging was effective when used in the Project Area in 1995. This may be the only technology that can effectively remove sediments under the apron.

The approach for processing the dredged slurry would need to be further developed in the design. The preferred dewatering solution will need to be based on projected volume estimates for the slurry, availability of space, disposal, sampling, and treatment requirements, and may include a bench-scale trial to test the feasibility for using Geotubes.

Micro-dredging is retained for further evaluation because it meets the RAOs and is the best dredging technology for a site with significant access limitations.

8.1.5 Supporting Technologies

Supporting technologies include water and sediment processing, treatment, and disposal, and erosion and sediment resuspension controls. These technologies are further described below. It is anticipated that these will be further developed during the design process.

8.1.5.1 Water Treatment and Disposal

Water treatment and disposal includes the applicable technologies to handle the water, sediment, or slurry generated from impacted sediment removal activities. Water treatment and disposal would not be needed if capping alone is the selected remedy.

Dewatering strategies separate water from the sediments to reduce the volume and weight of sediments generated for disposal. Liquids can be removed from sediments by passive, mechanical, or chemical methods.

Treated water may be discharged back to the surface water or into the sanitary sewer. These methods are likely to require treatment prior to disposal, such as filtering through granular activated carbon, or other functionally similar treatment methods, to meet water-quality limits depending on the location of discharge.

8.1.5.2 Erosion and Resuspension Controls

Erosion and resuspension controls are required during implementation of the chosen remedial technologies. These technologies would be needed for both the capping and dredging options. There are two principal methods for erosion and resuspension controls for in-water work: silt curtains and sheet pile:

Silt Curtains – Silt curtains consist of a permeable filter fabric intended to capture sediments suspended during the removal that is attached to a floating buoy as well as being actively anchored to the sea bed.

Sheet Pile – Sheet pile walls form a rigid barrier that are driven into the sediment to prevent migration of water and sediment between the area of removal and the outside water column.

Silt curtains are generally not as effective as sheet pile in controlling resuspended sediment. However, the resuspension options are limited due to site conditions. Installation of sheet pile may not be feasible in the remedial action area due to the presence of the wharf and concrete apron, and facility operations. The cost of installing sheet pile is substantially higher than silt curtains. Silt curtains are a reasonable engineering control at this location, if the dredging approach is hydraulic dredging or micro-dredging.

8.1.5.3 Sediment Transport/Disposal

Sediment disposal will be required for the sediment removed from the Project Area. Sediments would be disposed of at an offsite landfill. There could be a variety of options and processes for transporting the sediment to the disposal location. The onsite contractor may haul it offsite, a hauling service could pick it up, or the sediment could be loaded onto a barge and then transferred to a truck for final treatment or disposal. However, given the relatively small volume of sediment that would be removed under a dredging scenario, truck transport is the most feasible option.

8.2 Evaluation of Subtidal Area Remedial Alternatives

Three remedial action alternatives were developed for the Subtidal Area based on the technology screening. These alternatives are described below.

Alternative 1 – No Action: Alternative 1 would not include any remedial actions. It has been retained for comparative purposes only.

Alternative 2 – Micro-Dredging: Alternative 2 consists of removing sediments in the remedial action area in the Subtidal Area by diver-assisted micro-dredging. The dredging depth would be 2 ft bss, which is the depth of elevated metals and PCB concentrations in the hot spots defined in Section 5.2. Silt curtains would be used to control potentially re-suspended sediment. The dredged sediment would be dewatered and disposed of offsite. The drained water would be treated and discharged either back to the surface water or to the sanitary sewer.

Alternative 3 – Micro-Dredging and Capping: Alternative 3 consists of removing sediments in the remedial action area in the Subtidal Area by diver-assisted micro-dredging, as described above. In addition, a 2-foot-thick sand cap would be placed in the dredged areas. The sand cap would be monitored and maintained, as needed, in perpetuity.

The following criteria were considered in evaluating the remedial alternatives:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume
- Short-term effectiveness
- Implementability
- Cost

The detailed evaluation of alternatives is presented in Table 6. The results of the screening are summarized below.

8.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the restoration time frame, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to maintain effectiveness. Given the lack of unacceptable risk posed by the COCs, as determined by the ERA, the primary objective of conducting remedial action in the Subtidal Area is to eliminate exposure of potential receptors to sediment hot spots.

- *Alternative 1 (No Action)* – This alternative would not be effective because metals do not degrade over time and PCBs are persistent chemicals that degrade very slowly.
- *Alternative 2 (Micro-Dredging)* – This alternative would be effective over time because sediments with the highest COC concentrations would be permanently removed.
- *Alternative 3 (Micro-Dredging with Sand Cap)* – This alternative would be effective over time because sediments with the highest COC concentrations would be permanently removed. The addition of a sand cap would further reduce risk to ecological receptors by eliminating the pathway to underlying sediments. Long-term monitoring and maintenance activities are needed to ensure that the cap does not erode.

Alternative 3 has the highest long-term effectiveness, followed closely by Alternative 2. Alternative 1 is the least effective.

8.2.2 Reduction of Toxicity, Mobility or Volume

This criterion assesses the ability of the alternatives to reduce the toxicity, mobility, or volume.

- *Alternative 1 (No Action)* – This alternative does not reduce the toxicity, mobility, or volume of the affected sediment.
- *Alternative 2 (Micro-Dredging)* – Alternative 2 would reduce the toxicity and mobility of the affected sediment by removing sediment with the highest COC concentrations; however, volume would not be reduced because the dredged sediments would be placed in a landfill.
- *Alternative 3 (Micro-Dredging with Sand Cap)* – Alternative 3 would also reduce the toxicity and mobility of the affected sediment by removing sediment with the highest COC concentrations. The addition of a sand cap would eliminate the direct pathway for aquatic receptors to the underlying sediments, and reduce their mobility, in the remedial action area. Volume would not be reduced because the dredged sediments would be placed in a landfill.

Alternative 3 provides the highest level of toxicity and mobility reduction, followed closely by Alternative 2. Alternative 1 does not reduce toxicity, mobility, or volume.

8.2.3 Short-Term Effectiveness

Management of short-term risks is the degree to which human health and the environment are protected during implementation of the alternative.

- *Alternative 1 (No Action)* – Because no work would be done, there are no short-term risks posed by the action.
- *Alternative 2 (Micro-Dredging)* – This alternative would pose some risk to divers involved in the micro-dredging due to physical hazards and potential exposure to impacted sediments. Sediment disturbance will result in a certain amount of sediment resuspension. Silt curtains would be used to control the resuspended sediment. Handling of dredged sediment, including dewatering, loading on trucks, and transport to a disposal facility, introduce nominal risks due to traffic, physical hazards, and the transport of impacted sediment through the local community.
- *Alternative 3 (Micro-Dredging with Sand Cap)* – The short-term risks associated with Alternative 3 are similar to those associated with Alternative 2, with additional risks associated with the placement of a sand cap in the excavated areas, which would involve additional heavy equipment and import and placement of sand.

Alternative 1 has the highest short-term effectiveness. Alternative 3 has the lowest short-term effectiveness.

8.2.4 Implementability

Implementability is the relative difficulty of implementing a given remedial action. Evaluation of implementability includes consideration of technical factors, such as the availability of mature technologies and experience of contractors to accomplish the cleanup work. It also includes administrative factors associated with permitting and completing the remedial action.

- *Alternative 1 (No Action)* – Because no work would be done, the implementability factor is limited to the ability to gain acceptance of the alternative from regulatory agencies and property owner, the Port of Redwood City.
- *Alternative 2 (Micro-Dredging)* – This alternative would be implementable in the remedial action area. Micro-dredging was previously successfully used in the Project Area.
- *Alternative 2 (Micro-Dredging with Sand Cap)* – Micro-dredging was previously successfully used in the Project Area. However, specialized equipment would be needed to place capping material under the apron and the wharf, which would require additional design considerations and planning. Capping has not been previously implemented in the Project Area.

Alternative 1 is the most implementable from a technical perspective, but least implementable based on administrative factors. Alternative 2 is more implementable than Alternative 3.

8.2.5 Cost

Cost factors associated with completing the remedial action include design, permitting, labor, materials, equipment, disposal, long-term monitoring and maintenance, and, potentially, mitigation.

- *Alternative 1 (No Action)* – There would be no cost because no work would be done.
- *Alternative 2 (Micro-Dredging)* – The major costs for this alternative include permitting, labor, equipment, and disposal.
- Alternative 3 (*Micro-Dredging with Sand Cap*) – The costs factors would be similar to Alternative 2, except for additional costs associated with import sand, placement, and long-term monitoring and maintenance.

Alternative 1 has the lowest cost, followed by Alternative 2 and then Alternative 3, which has the highest cost.

8.3 Preferred Alternative for the Subtidal Area

The results of the screening comparison process are summarized on Table 6.

Based on the scoring and ranking of the alternative in accordance with the screening criteria above, Alternative 2 is selected as the preferred alternative for the Subtidal Area.

- Alternative 1 (No Action) does not meet RAOs.
- Alternative 2 (Micro-Dredging) is the recommended alternative. Alternative 2 will meet the RAOs because it will remove hot-spot sediments and reduce risk.
- Alternative 3 (Micro-Dredging with Sand Cap) would also meet RAOs, with an incremental reduction in risk and mobility relative to Alternative 2, but its cost is higher and implementability is lower, and cost is higher than for Alternative 2 due to the challenges associated with placing a sand cap under structures.

9.0 PREPARATION, PLANNING, AND PERMITTING

9.1 Design Criteria Report and Remedial Design

Upon EPA approval of the SRP, Sims will prepare a Design Criteria Report ("Design Report").

The Design Report will describe, in detail, the technical parameters upon which the remedial design will be based. These parameters include, among other factors: the design criteria; waste characterization; volumes and types of medium requiring removal; fill specifications and volume; performance standards; compliance with applicable local, state, and federal governmental requirements; and technical factors of importance to the project design and implementation.

Engineering plans and specifications will be prepared following EPA approval of the Design Report; plans and specifications are currently anticipated to be prepared at the 50% (preliminary), 90% (pre-final), and 100% (final) level.

9.2 Quality Assurance Plan

The Design Report will include a draft Quality Assurance Plan (QAP). The QAP will describe the quality-control (QC) measures and procedures that will be followed during the implementation of the field work to ensure that the remediation meets design specifications. Following the receipt of the regulatory permits, the QAP will be updated, as necessary, to include additional criteria specified in the permits. The QAP includes a description of the QC roles, responsibilities, reporting procedures, and submittal register. A final QAP will be included with the 100% design package.

9.3 Noise Control Plan

The Project Area is in an active heavy industrial area far from neighbors who might be bothered by the work. A Noise Control Plan is not anticipated to be needed.

9.4 Dust Control Plan

The planned implementation activities are not anticipated to result in air emissions that exceed National Emissions Standards for Hazardous Air Pollutants or National or State Ambient Air Quality Standards, require a Prevention of Significant Deterioration program, or become subject to New Source Performance Standards. Therefore, a Dust Control Plan is not required for this project.

9.5 Stormwater Pollution Prevention Plan and Erosion Control Plan

Dischargers whose project disturbs one or more acres of soil are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ. The amount of disturbed land as part of the project will be less than one acre; therefore, the work is not governed by this permit.

9.6 Mobilization

9.6.1 Cap Material Verification

A source for the sand isolation cap for the Riprap Area will be identified in the Design Report. The cap material will be tested for metals and PCBs prior to acceptance of the source. As needed, the cap material will be tested for physical parameters (e.g., grain size). The cap material will need to be free of COCs. The cap material will not contain PCBs above the detection limit, nor metals above the local background established in the *Final Sediment Investigation Report* (Terraphase 2018).

9.6.2 Equipment and Material Staging

An upland staging area will be required to stockpile clean sand for the isolation cap. In addition, an upland storage area can be used by subcontractors to stage unused equipment and for a field office during the implementation activities. The staging area and details will be identified in the Design Report.

9.6.3 Installation of Engineering Controls

The engineering controls required will be specified in the Design Report.

9.7 Permitting

The permitting process will involve the preparation and submittal of a Joint Aquatic Resource Permit Application (JARPA). The JARPA enables permit applicants to prepare one permit application. JARPA is a useful tool that streamlines the submittal of the initial permit application, while providing for each permitting agency's resource-specific comments. Initial agency pre-application meetings are the first step in permitting the project.

Environmental permits will likely be needed from the USACE, the San Francisco Bay Conservation and Development Commission (BCDC), and the San Francisco Regional Water Quality Control Board (Water Board). The following resource agencies will also likely require consultation: the United States Fish and Wildlife Service (USFWS), the National Oceanographic and Atmospheric Administration Fisheries Division (NOAA Fisheries), the San Francisco Bay Dredge Material Management Office, and the California Department of Fish and Wildlife.

A summary of regulatory agencies and other information associated with anticipated aquatic permits is provided in Table 7.

9.8 Other

- Local municipal building/other permits may be required.
- Access agreements or licenses may be needed for the use of upland areas, if any, that are not currently under the control of Sims for equipment staging and materials handling/processing.

- Offsite landfill disposal of the dredged materials will require profiling for disposal.
- Design and other documents will need to be submitted to the Port of Redwood City for review and approval.

10.0 PRELIMINARY SCHEDULE AND COORDINATION

Major anticipated milestones associated with the proposed remedial action are listed below, along with a preliminary estimate of the durations and completion in elapsed days after approval of the SRP.

Item	Duration (Days)	Days after EPA Approval of SRP
Pre-Design Investigations	90	90
Design Criteria Report Submittal to EPA	45	135
50% Design Plans Submitted to EPA	30	165
90% Design Plans and Specifications to EPA	90	255
EPA Approval	30	285
Permitting	120	405
Bidding	21	426
Contractor Selection	14	440
Implementation Planning/Mobilization	60	500
Implementation	45	545
Remedial Action Completion Report	60	660

10.1 Implementation Issues

10.1.1 Environmental Work Window

Environmental work windows related to the California Least Tern may apply to dredging in the Subtidal Area in accordance with the *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS) Management Plan.* Depending on the implementation timing, consultation with NOAA Fisheries, the USFWS, and the CDFG may be required.

We do not expect that environmental work windows would apply to the placement of a sand cap in the intertidal Riprap Area because the placement of sand will be conducted during low tide while the remedial action footprint is dry.

10.1.2 Coordination

Periodic ship-loading operations that are part of the business of Sims, and ship unloading operations that are part of the business of other users of Wharf 3, may affect implementation. For safety reasons, Sims will restrict implementation during ship-loading or vessel unloading. Ongoing communication among the contractor, consultant, and Sims will minimize the interruption to implementation of the remedial action.

11.0 HEALTH AND SAFETY, SECURITY, AND NOTIFICATIONS

11.1 Special Training/Certification

Work in the Project Area would be performed in accordance with the Hazardous Waste Operations and Emergency Response training requirements and other requirements in 29 CFR 1910.120(e) and California Occupational Safety and Health Administration (OSHA) Title 8 Section 5192(e).

11.2 Health and Safety Plan

The consultant and contractor would be required to prepare a site-specific health and safety plan (HASP) prior to project implementation.

All fieldwork would be monitored according to the HASP to ensure that appropriate health and safety procedures were being followed. A copy of the HASP would be kept onsite during scheduled field investigation activities. When working over or near water, implementation personnel would need to use a United States Coast Guard-approved life jacket or buoyant work vest, and conduct work in accordance with the OSHA requirements of 29 CFR 1926.106.

11.3 Security

At all times, at least one, and possibly most if not all, site workers involved in project implementation, would need to hold Transportation Worker Identification Credentials, as required by the Port of Redwood City, in accordance with the Port's Facility Security Plan.

11.4 Notifications

Notifications of work dates would be provided to applicable agencies, including the Water Board and the BCDC, in accordance with required permits.

Additionally, all Project-Area work must be approved and coordinated with the Port of Redwood City, in accordance with applicable requirements.

12.0 REFERENCES

California Department of Toxic Substances Control (DTSC). 1996. Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities. Part A: Overview. California Environmental Protection Agency, Department of Toxic Substances Control, Human and Ecological Risk Division, Sacramento, CA.

HydroPlan LLC (HydroPlan). 2015. Draft Integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report. Redwood City Harbor Navigation Improvement Feasibility Report and Integrated EIS/EIR. Prepared for U.S. Army Corps of Engineers, San Francisco District. HydroPlan LLC, in collaboration with GAIA and Moffatt and Nichol.

PES Environmental, Inc. (PES) 1996. Sediment Removal Report, Sims Metal America Shiploader Conveyor Area, Wharf No. 3, Port of Redwood City, Redwood City, California USA. August 16.

San Francisco Estuary Institute. 2016. Technical Memorandum, Updated Ambient Concentrations of Toxic Chemicals in the San Francisco Bay Area Sediments.

Terraphase Engineering Inc. (Terraphase). 2016. Final Sediment Sampling and Analysis Plan and Quality Assurance Project Plan, Sims Metal Management, Redwood City, California. March 31.

________. 2018. Final Sediment Investigation Report. March 1.

United States Environmental Protection Agency (EPA). 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. EPA/540/R-97/006. Interim final. Environmental Response Team, US Environmental Protection Agency, Edison, NJ.

________. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002 F. Risk Assessment Forum, US Environmental Protection Agency, Washington, DC.

________. 2016. U.S. EPA Conditional Approval Letter for the Final Sediment Sampling and Analysis Plan in Accordance with Section V, Paragraph 13.b of the Consent Decree. April 25.

TABLES

Table 1
Estimated Riprap Remediation Area and Sand Cap Volume
Sediment Remediation Plan
Sims Metal Management
Redwood City, California

Location	Square Feet	Square Yards
W3-12	426	47
W3-14	229	25
W3-15	320	36
W3-22	344	38
W3-23	196	22
W3-24	257	29
W3-25	460	51
W3-27	359	40
TOTAL	**2591**	**288**

Volume of Sand Cap (cubic yards)	**200**

Notes:
1. Area calculations based on Thiessen polygons shown on Figure 5.
2. Volume calculation based on a 2-foot thickness of sediment.

Table 2
Estimated Subtidal Remediation Area and Dredge Volume
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Location	Square Feet	Square Yards
W3-6	477	53
W3-7	567	63
W3-8	407	45
W3-41	580	64
W3-43	462	51
W3-43	517	57
TOTAL	**3010**	**334**

Volume of Dredge (cubic yards)	**223**

Notes:
1. Area calculations based on Thiessen polygons shown on Figure 7.
2. Volume calculation based on a 2-foot thickness of sediment.
3. Dredge area and volume may be adjusted during the design and constructability evaluation.

Table 3
Remedial Technology Screening - Riprap Area of Concern
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Remedial Technology Type	Process Option	Description	Advantages	Disadvantages	Carried Forward to Evaluation?
No Action	Not Applicable	Does not include any remedial actions, such as removal, containment, treatment, engineering controls, or new institutional controls.	Would not cause disruption to facility operations and would have no costs. The fate of some of the contaminants present may be reduced over time by natural attenuation processes such as biodegradation, chemical stabilization, dispersion and sorption.	Does not effectively reduce risk in a reasonable timeframe.	Yes, for comparison purposes
Institutional Controls	Deed and Use Restrictions	Administrative or legal controls such as fish consumption advisories, waterway use restrictions, site access restrictions, and environmental easements would be implemented.	Can reduce exposure to contaminants and may be combined with other remediation technologies to enhance the success of other remedies that may be selected.	Institutional controls are typically used in conjunction with other remedial solutions rather than as a stand-alone remedy. This remedy would not be effective at reducing contaminant concentrations in sediments. Sims does not own the riprap and therefore cannot restrict its use.	No
Removal/ Excavation	Remove & Replace	Excavate the riprap and underlying sediment and replacement with like materials.	Offsite recycling of existing riprap is likely acceptable. Reuse of some of the materials may be possible. Can be designed to comply with the no net fill policy.	If the existing riprap is re-used, an assessment of the rock surface may be required, and washing the rocks may also be necessary. Processing rocks on the shoreline would require additional controls, and analysis of the resulting waste generated, and would not be an energy-efficient process.	No
Containment / Capping	Shotcrete	Shotcrete is a process to apply a concrete mixture that cures faster and provides an impermeable layer. The ingredients are mixed and introduced into the delivery equipment where the wet material is pumped to a hose nozzle and compressed air is added to shoot the material onto the receiving surface. The high velocity helps consolidate the material.	A concrete curing accelerator can be added to the concrete to reduce the curing time needed for installation of shotcrete. Shotcrete is effective at isolating underlying sediments as it forms an impermeable layer.	Short duration between tidal cycles may not be adequate to allow the concrete to fully cure before getting submerged after installation. Considerable volume of material may be required to ensure complete coverage of the irregular surface. Shotcrete would not adhere to the riprap where mud overlays the rock. Concrete is alkaline and may cause release of high-pH slurry to water.	No
	Isolation Sand	A sand cap is placed between and around riprap rocks to physically isolate and stabilize the contaminated sediments.	Prevents potential exposure of environmental receptors to the contaminated sediment. It is a standardized technology where 1-2 foot thickness is commonly adequate to isolate the contaminated sediment. Installing in the areas under the apron could be accomplished by a telebelt truck positioned on the apron or the shoreline. Would prevent erosion of impacted sediment.	Sand alone will erode more rapidly than the armored surface currently in-place. It would require periodic inspection and potential replenishment to continue to function as an isolation cap.	Yes
	Isolation - Sand and Articulated Block Mat	An isolation cap constructed of an articulated block mat forms a hard armor to prevent erosion. Prior to placement of the mat, a sand layer would be placed in the riprap to create a flat surface. The mat would be placed either directly on the fill layer, or over a geotextile covering.	Prevents potential exposure of environmental receptors to the contaminated sediment. It is a standardized technology where 1-2 foot thickness is commonly adequate to isolate the contaminated sediment. Installing in the areas under the apron could be accomplished by a telebelt truck positioned on the apron or the shoreline. Would prevent erosion of impacted sediment. Maintenance requirements are lower compared to sand cap alone.	Some difficulty may be encountered during installation under the concrete apron and vehicle ramp. This alternative will conflict with the no net fill policy; mitigation measures may be required.	Yes

Table 4
Comparative Evaluation of Remedial Alternatives – Riprap Area of Concern
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Alternative	**Alternative Description**	**Evaluation Factors and Scoring**					
		Long-term effectiveness and permanence *(5 = highly effective)*	Reduction of toxicity, mobility or volume *(5 = large reduction)*	Short-term effectiveness *(5 = low adverse effect)*	Implementability *(5 = easy to implement)*	Cost *(5 = low cost)*	**Total Average Score**
Alternative 1 - No Action	No remedial actions such as removal, containment, treatment, engineering controls, or new institutional controls would be implemented.	1	1	5	3	5	3.0
Alternative 2 - Sand Cap	A sand cap is placed to physically isolate and stabilize the contaminated sediments.	4	4	4	4	4	4.0
Alternative 3- Sand Cap with Articulated Block Mat	An isolation cap constructed of a sand or gravel layer with an articulated block mat placed on top. The mat can be placed directly on the fill or over a geotextile covering.	5	4	4	3	3	3.8

Table 5
Remedial Technology Screening - Subtidal Area of Concern
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Remedial Technology Type	Technology Process Option(s)	Description	Advantages	Disadvantages	Carried Forward in Alternatives Evaluation
No Action	Not Applicable	Does not include any remedial actions, such as removal, containment, treatment, engineering controls, or new institutional controls.	Would cause disruption to facility operations and would have no costs. The fate of some of the contaminants present may be reduced over time by natural attenuation processes such as biodegradation, chemical stabilization, dispersion, and sorption.	Does not effectively reduce risk in a reasonable timeframe.	**Yes, for comparison purposes**
Institutional Controls	Deed and Use Restrictions	Administrative or legal controls such as fish consumption advisories, waterway use restrictions, site access restrictions, and environmental easements would be implemented.	Can reduce exposure to contaminants and may be combined with other remediation technologies to enhance the success of other remedies that may be selected.	Institutional controls are typically used in conjunction with other remedial solutions rather than as a stand-alone remedy. This remedy would not be effective at reducing contaminant concentrations in sediments. Sims does not own the subtidal area and therefore cannot restrict its use.	No
Capping	Isolation Layer	A sand cap approximately 2 feet in depth is placed to physically isolate and stabilize the contaminated sediments in place.	Prevents potential exposure to aquatic receptors to contaminants present in the sediment as a result of sediment resuspension and transport. Isolation layers are a standardized technology, where 1-2 feet thicknesses are commonly adequate to isolate the contaminated layer. Installing the isolation layer in areas not covered by the apron or wharf could be done by using a telebelt truck positioned on the apron or the shoreline.	Additional design considerations include: bioturbation, consolidation, erosion, bathymetric survey, construction and operational issues related to the cap's ability to isolate contaminants. This remedy requires specialized construction equipment for a water-based delivery system to place capping material under the apron and the wharf. A water-based delivery system is likely to involve multiple handling steps for delivery, such as crane-loading to a hopper and conveyor from a barge to the capping areas. Long-term monitoring and maintenance activities are needed to ensure the cap does not erode. Any fill placed would have to meet the no net fill policy.	**Yes**
Dredging	Mechanical Excavation	Excavation involves the removal of sediment by using earthmoving equipment (e.g., excavator and backhoe). Mechanical excavation can be undertaken in either dry conditions or in the wet. For dry excavation, the excavation area must first be dewatered. Sheet pile walls are installed to dewater the remedial action area for excavation. For wet excavation, the excavator would directly dig through the water column.	Based on a preliminary site inspection by a dredging contractor, excavation from shore using a long-reach excavator is feasible in areas that are not under the wharf or apron.	Removal of sediments with mechanical excavation is impractical due to the presence of consolidated sediments and access issues under the wharf and concrete aprons. Mechanical excavation will result in sediment resuspension and turbidity which increases the short-term exposure to aquatic receptors from contamination that may be present in the sediment and will increase energy use for processing and disposal.	No
	Mechanical Dredging	Mechanical dredging typically involves the use of a suspended or manipulated bucket (e.g., clamshell or environmental) that collects the sediment and raises it to the surface via a cable, boom, or ladder. The sediment is deposited on a haul barge or other vessel for transport to a processing location.	Reduces amount of dewatering, sediment processing and treatment required following sediment removal. Less waste is typically generated.	Restricted access makes mechanical dredging impractical under and around the wharf and concrete aprons.	No
	Hydraulic Dredging	Hydraulic dredging removes sediments with hydraulic suction. The sediments are then pumped through a pipeline to a barge or directly to a processing or disposal site. Common hydraulic dredges include cutterhead, horizontal augers, and plain suction heads.	Hydraulic dredging is feasible.	Locating and mobilizing equipment to this site may present challenges. Technology available for hydraulic dredging will produce a higher volume of sediment slurry than mechanical dredging resulting in additional costs for dewatering and treatment. May have negative impact on the infrastructure, i.e., the footings for the wharf and apron, because the amount of sediment removed would be hard to control, especially under the structures.	No
	Micro-dredging	Micro-dredging involves divers or remotely operated vehicles to dredge sediment in areas where access or obstructions prevent larger conventional dredging equipment to be deployed. If feasible, the dredge material would be pumped directly to an upland dewatering/processing area.	This technology was effective when used at the site in 1995. This may be the only technology that can remove sediments under the apron.	Prior to implementation, available contractors should be consulted to address the limited ability of the equipment in areas around the apron, and where consolidated sediments may be encountered.	**Yes**

Table 5
Remedial Technology Screening - Subtidal Area of Concern
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Remedial Technology Type	Technology Process Option(s)	Description	Advantages	Disadvantages	Carried Forward in Alternatives Evaluation
Supporting Technologies					
Water Management	Dewatering from Hydraulic or micro-dredging	Hydraulic dredging produces a sediment-water slurry. The slurry may contain 2,000 or more gallons of seawater per in-situ cubic yard of sediment dredged. The water fraction needs to be reduced to decrease volume and weight and meet requirements for sediment disposal facilities. The free liquids will be separated through passive or mechanical methods and the addition of additives. Passive dewatering utilizes gravity for filtration rather than pressurized systems.	Passive dewatering using Geotubes is a cost-effective solution for both hydraulic and micro-dredging technologies. Geotubes are geotextile fabric bags that receive the pumped slurry and separate the water from the sediments.	The approach for processing the slurry will need to be further developed in the design. The preferred dewatering solution will need to be based on projected volume estimates for the slurry, availability of space, disposal, sampling and treatment requirements, and may include a bench-scale trial to test the feasibility for using geotubes.	**Yes**
	Discharge	Treated water may be discharged back to San Francisco Bay, likely requiring a final polishing using granular activated carbon (GAC), or other similar treatment technology. It may also be possible to dispose of the untreated water back to the sanitary sewer, as was done in 1995.	Discharge to sanitary sewer is ideal, with a good location to discharge the water available on the nearby right-of-way.	Discharging treated water to the Bay or sanitary would require evaluating the quality of the water, identify cost-effective treatment options, and a review of current permitting requirements with numerous regulatory agencies to obtain approval to discharge.	**Yes**
Resuspension Controls	Silt Curtains	Silt curtains typically consist of a permeable filter fabric attached to a floating buoy and anchored to the seabed. They are most often used in shallow water settings where currents are low and tidal fluctuation is minimal.	Silt curtains are a reasonable engineering control at this location, if the dredging approach is hydraulic dredging or micro-dredging.	Bathymetric survey and tidal information is needed to assess the feasibility and recommended approach for installation of the curtains. Silt curtains are not recommended in EPA and USACE guidance where velocities exceed 50 cm/sec and at depths greater than 20 feet. Silt curtains are not as effective as sheet pile. However, the options for perimeter controls may be limited due to site conditions.	**Yes**
	Sheet Pile	Sheet pile walls are rigid vertical barriers that are driven into the soil or sediment surface. Sheet pile can be made from a variety of materials, although steel is typically used. The edges of the sheets fit together with interlocking joints to form a continuous wall. The sheets are generally installed by driving with impact or vibratory hammers hoisted from a crane assembly.	Sheet pile is an effective resuspension control, particularly if mechanical excavation is the chosen technology.	Installation of sheet pile may not be feasible in the remedial action area due to the wharf, concrete apron, facility operations, higher cost, and effectiveness when compared to silt curtain.	No
Sediment Transport/ Disposal	Trucking to Landfill	Disposal of contaminated sediments at an offsite landfill.	Following on-site dewatering, treatment and stabilization, disposal at an off-site facility is possible. Given the small volume of sediment anticipated to be generated from this project area (155 CY) trucking is an efficient transportation method.	Disposal options will need to be evaluated during the design process. Rail transport may also be feasible.	**Yes**

Table 6

Comparative Evaluation of Remedial Alternatives – Subtidal Area of Concern

Sediment Remediation Plan

Sims Metal Management, Redwood City, California

Alternative	Alternative Description	Evaluation Factors and Scoring					
		Long-term effectiveness and permanence *(5 = highly effective)*	Reduction of toxicity, mobility or volume *(5 = large reduction)*	Short-term effectiveness *(5 = low adverse effect)*	Implementability *(5 = easy to implement)*	Cost *(5 = low cost)*	**Total Average Score**
Alternative 1 - No Action	No remedial actions such as removal, containment, treatment, engineering controls, or new institutional controls would be implemented.	1	1	5	3	5	3.0
Alternative 2 - Micro-Dredging	Sediments removed by diver-assisted micro-dredging to 2 feet below sediment surface in the remedial action areas. Silt curtains to control potentially re-suspended sediment. Dredged sediment would be dewatered and disposed of offsite. The drained water would be treated and discharged either back to the surface water or to the sanitary sewer.	4	4	4	4	3	3.8
Alternative 3- Micro-Dredging with Sand Cap	In addition to features of Alternative 2, a 2-foot-thick sand cap would be placed in the dredged areas. The sand cap would be monitored and maintained, as needed, in perpetuity.	5	5	3	2	2	3.4

Table 7
Preliminary Summary of Potentially Applicable Permits
Sediment Remediation Plan
Sims Metal Management, Redwood City, California

Permitting Agency	Potential Permit Requirement	Supporting Technical Studies/Materials
U.S. Army Corps of Engineers	Section 404 - Nationwide Permit 32	Engineering drawings, details/specifications, supporting exhibits, mitigation plan (if necessary).
San Francisco Regional Water Quality Control Board (SFRWQCB)	Section 401 - Water Quality Certification	Engineering drawings, details/specifications, supporting exhibits, mitigation plan (if necessary).
Bay Conservation & Development Commission (BCDC)	BCDC Abbreviated Regionwide Permit	Engineering drawings, details/specifications, supporting exhibits, mitigation plan (if required).
Consolidated Dredging and Dredged Material Reuse/Disposal Application (DMMO)	DMMO Dredge Program Application	Engineering drawings, details/specifications, supporting exhibits, mitigation plan, disposal plan, and sampling and analysis plan (SAP).
California Department of Fish & Wildlife	Streambed Alteration Agreement for Projects Adjacent to Creeks, Streams, Lakes, and the Bay	Engineering drawings, details/specifications, supporting exhibits, agreement terms, notification related to orders by the court, mitigation and maintenance plans.
U.S. Fish and Wildlife Service (USFWS)	Potential consultation with the USFWS regarding potential impacts to jurisdictional wetlands and special-status species/habitat within and directly adjacent to project area	Engineering drawings, details/specifications, supporting exhibits, mitigation plan (if necessary).
Port of Redwood City	CEQA/NEPA - Initial Study & Mitigated Negative Declaration/EA	Project Description, Noise, Air Quality, Hydrology/Water Quality, Hazardous Materials, and Biological Resources (if applicable).
City of Redwood City	Grading/Building Permit	Drawings/City application.
SFRWQCB / South Bayside System Sewer Authority	SFRWQCB Dewatering Discharge Permit or South Bayside System Authority Sanitary Discharge Permit	Permit application, dewatering and disposal plan (if applicable).
California Lands Commission	California State Lands Commission CA State Lands Commission Land Management Division Lease/Use Permit	Permit application, engineering drawings, and disposal plan.

Notes:
1. A Joint Aquatic Resource Permit Application (JARPA) may be used as this project will involve several regulatory agencies.
2. The number of permits required will be resolved during the design process.

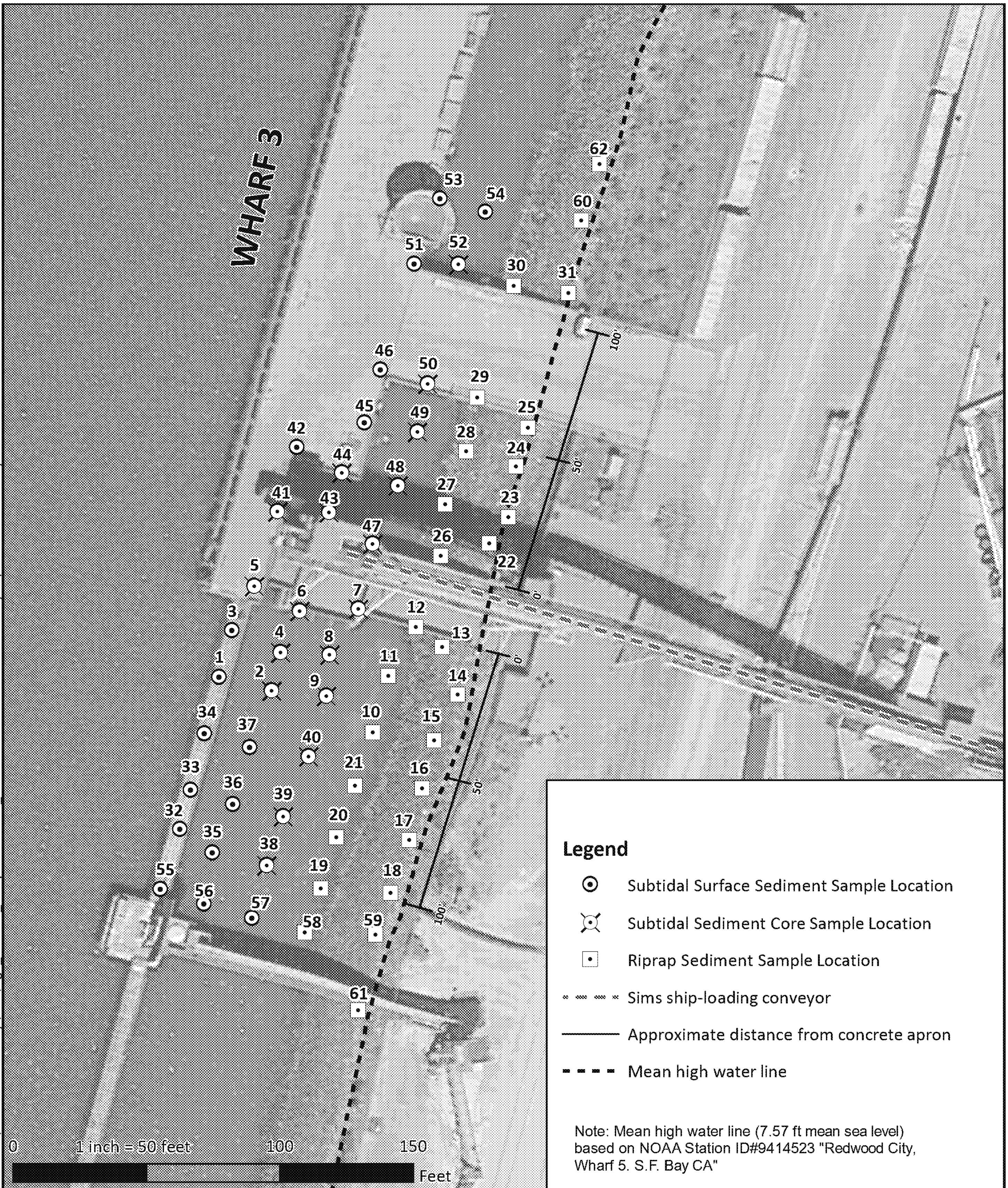
FIGURES

SAFETY FIRST	CLIENT: Sims Metal Management	**Site Location Map**
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: **0012.001.014**	**FIGURE 1**

File Name: Figure 1 – Site Location Map Prepared by: ptz Checked by: jrr

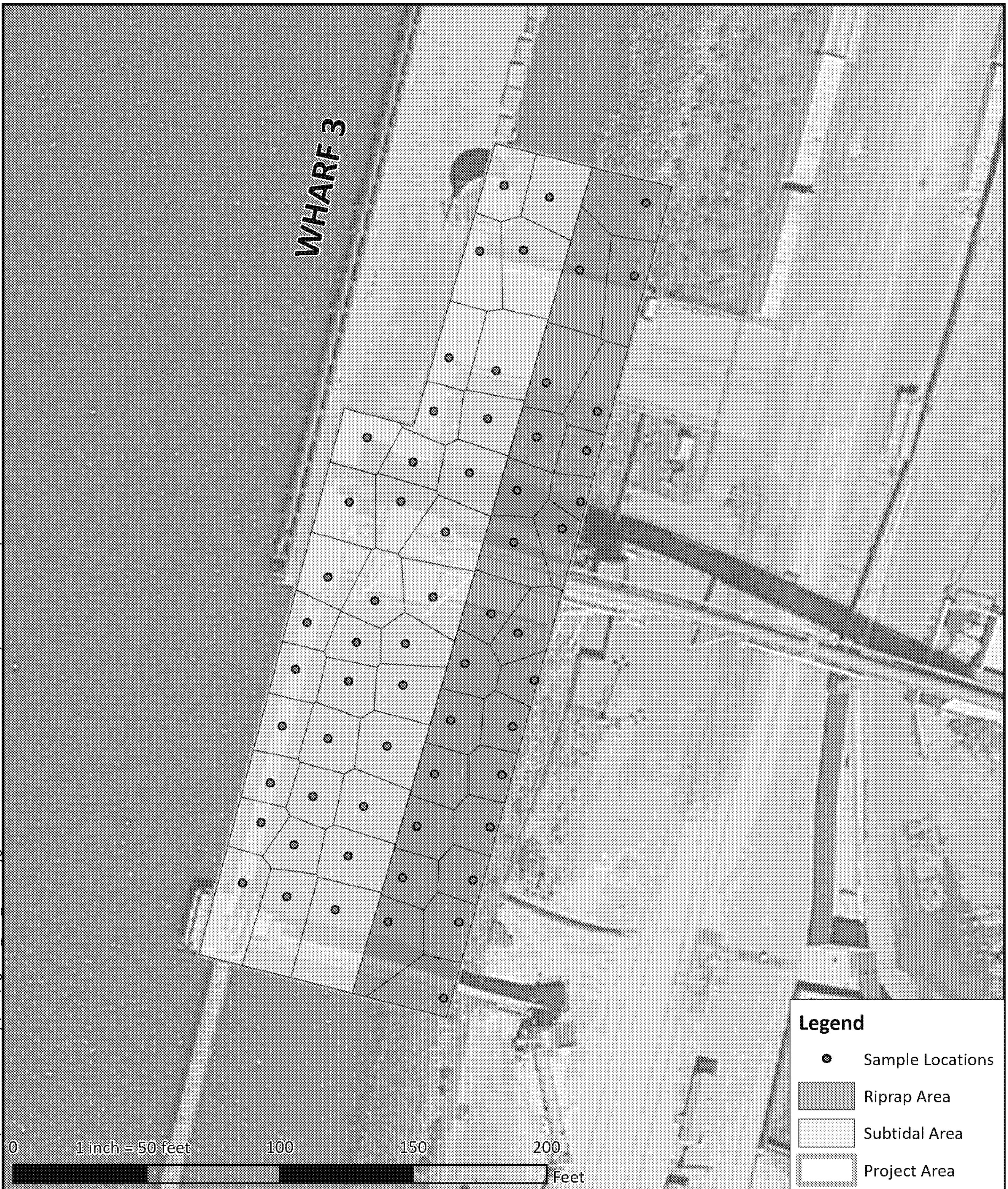
N	SAFETY FIRST	CLIENT: Sims Metal Management	**Project Area**
	terraphase engineering	PROJECT: Sediment Remediation Plan	
		PROJECT NUMBER: 0012.001.014	**FIGURE 2**

File: K:\GIS\Prj\0012 Sims Metals\001 Redwood City\SRP\Fig2_Project Area_0012-001-015.mxd Created by: DJR/JK/TLW Checked by: JW



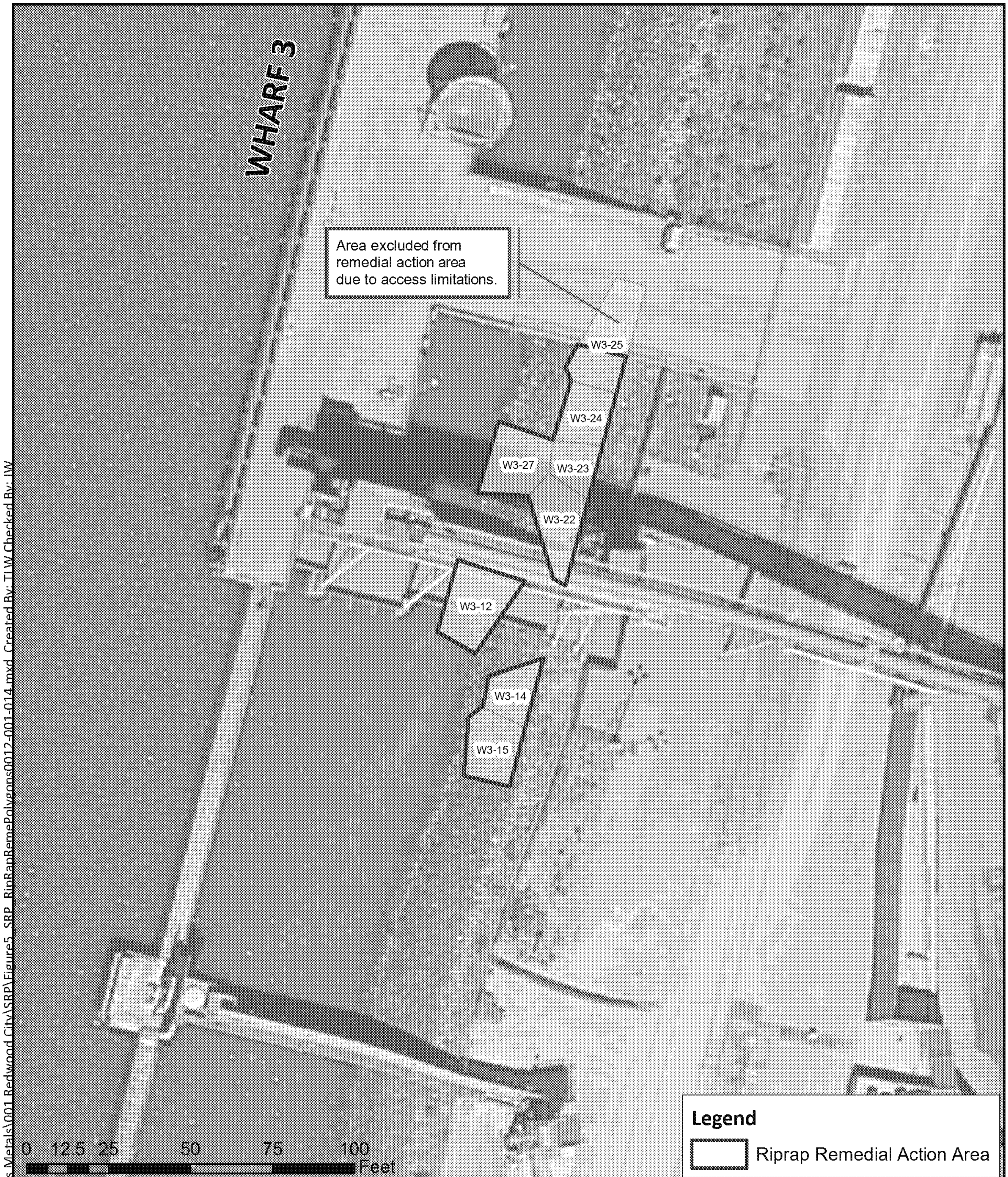
SAFETY FIRST	CLIENT: Sims Metal Management	Subtidal and Riprap Sediment Sample Locations Wharf 3
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	FIGURE 3

File: K:\GIS\Prj\0012 Sims Metals\001 Redwood City\SRP\Fig3_Wharf3_SampleLocations_0012-001-012.mxd Created by: JL/TLW Checked by: JW



File: K:\GIS\Prj\0012 Sims Metals\001 Redwood City\SRP\Figure4_SRP_AOCPolygons0012-001-014.mxd Created By: TLW Checked By: PZ

SAFETY FIRST	CLIENT: Sims Metal Management	**Project Area Thiessen Polygons**
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	**FIGURE 4**

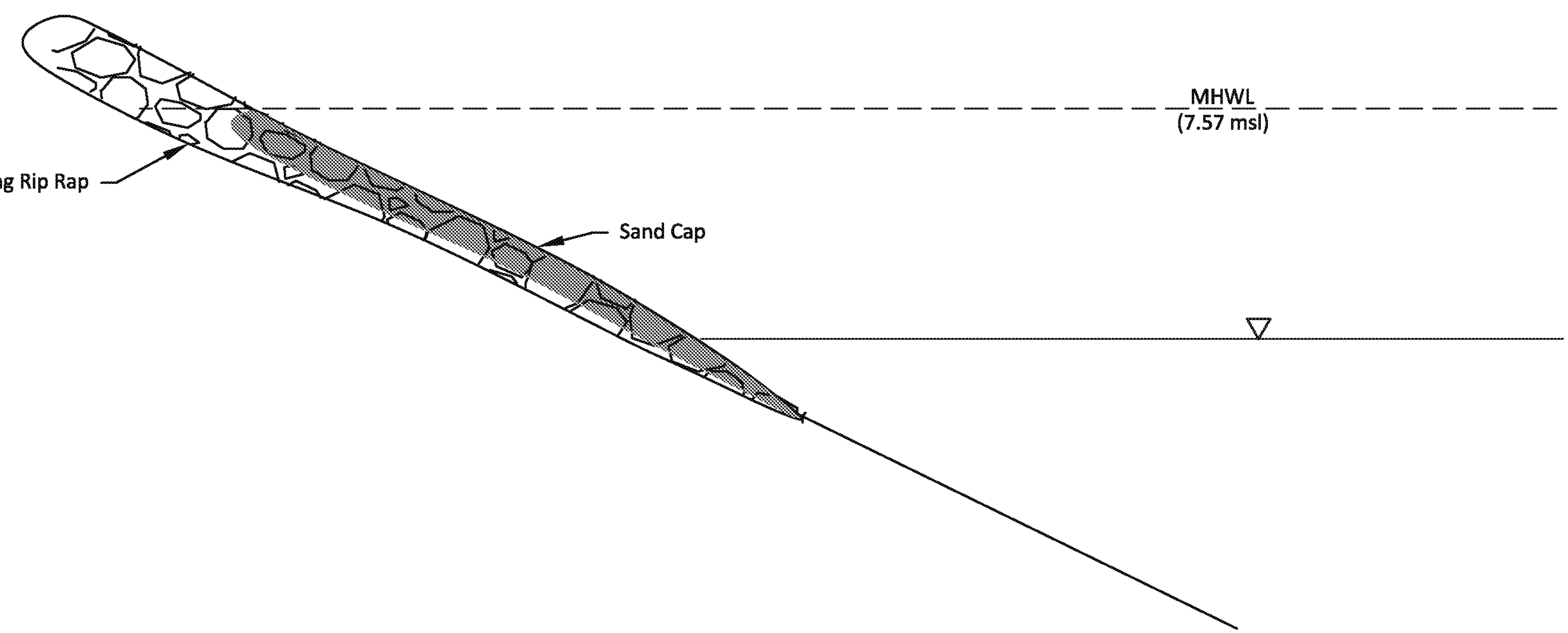


N

SAFETY FIRST	CLIENT: Sims Metal Management	**Riprap Remedial Action Area**
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	**FIGURE 5**

File: K:\GIS\Prj\0012 Sims Metals\001 Redwood City\SRP\Figure5_SRP_RipRapRemePolygons0012-001-014.mxd Created By: TLW Checked By: JW

J:\CADD FILES\0012 Sims Metal Management\001 Redwood City\(20180817) Conceptual Cross Sections.dwg



Drawing Not To Scale

SAFETY FIRST	CLIENT: Sims Metal Management	Riprap Conceptual Cross-Section Plan
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	Figure 6

N

SAFETY FIRST

terraphase engineering

CLIENT: Sims Metal Management

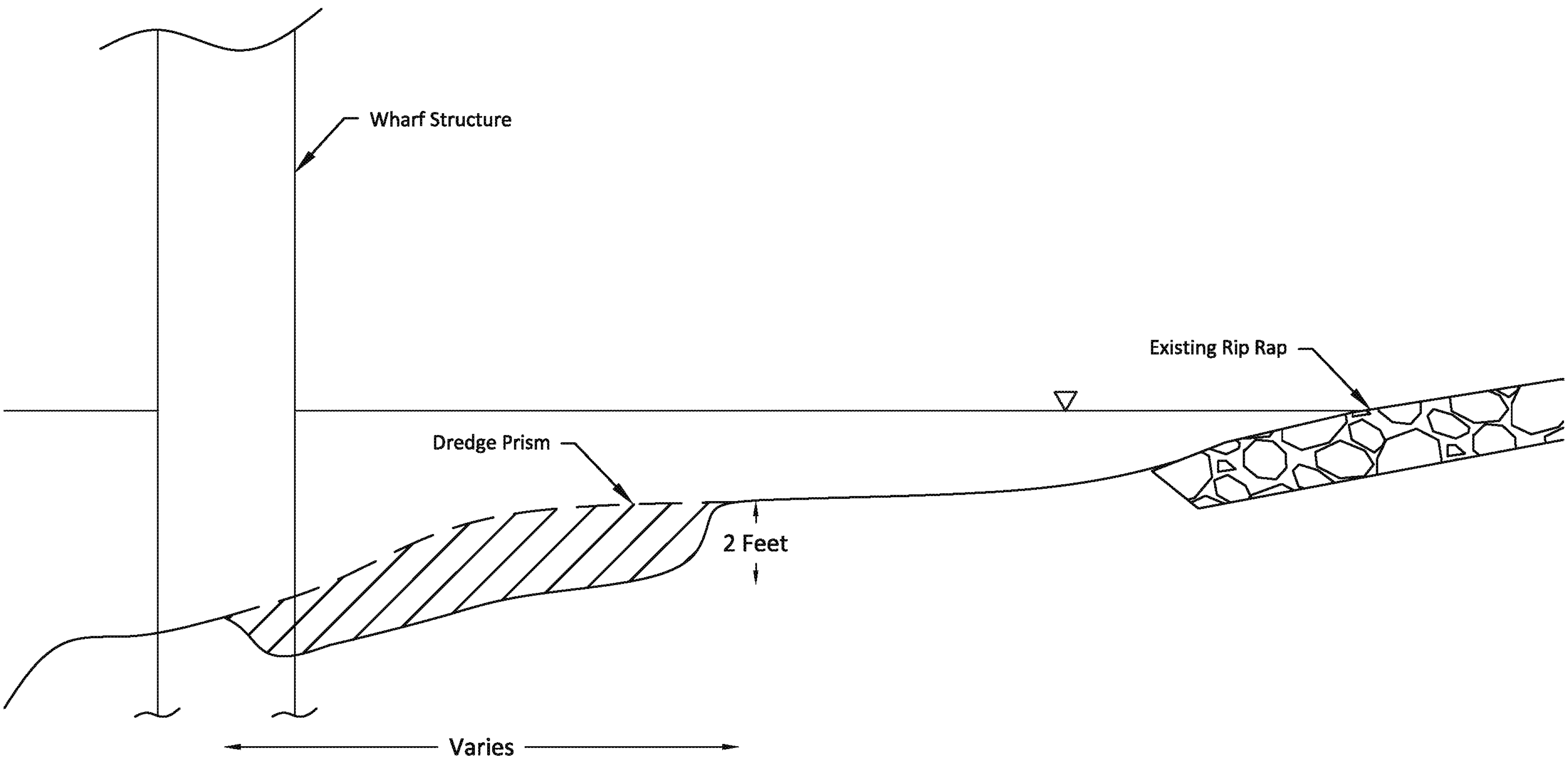
PROJECT: Sediment Remediation Plan

PROJECT NUMBER: 0012.001.014

Subtidal Remedial Action Area

FIGURE 7

File: K:\GIS\Prj\0012 Sims Metals\001 Redwood City\SRP\Figure7_SRP_SubtidalRemeActionArea0012-001-014.mxd Created By: TLW Checked By: PZ



J:\CADD FILES\0012 Sims Metal Management\001 Redwood City\(20180817) Conceptual Cross Sections.dwg

Drawing Not To Scale

SAFETY FIRST	CLIENT: Sims Metal Management	Subtidal Conceptual Cross-Section Plan
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	Figure 8

APPENDIX A

STATISTICAL SUMMARIES OF METALS AND PCB CONCENTRATIONS IN PROJECT-AREA SEDIMENT

Table A-1
Statistical Evaluation – Project Area, Riprap Locations
Sediment Investigation Report
Sims Metal Management, Redwood City, California

			Number Samples	Number Detects	Min	Max	Mean	Median	St Dev	95% UCL Concentration	95% UTL Concentration
Metals	Aluminum	mg/kg	26	26	7320	31300	18445	18000	6431	20599	33075
	Antimony	mg/kg	26	11	0.507	22.3	4.8	1.065	6.2	6.784	18.76
	Arsenic	mg/kg	26	26	9.23	158	42	20.1	39	75.52	158
	Barium	mg/kg	26	26	80.1	778	305	211.5	220	397.5	1226
	Beryllium	mg/kg	26	21	0.317	0.742	0.49	0.453	0.17	0.566	0.838
	Cadmium	mg/kg	26	26	0.555	17.4	4.9	3.215	4.4	6.768	26.39
	Chromium	mg/kg	26	26	85.8	488	177	139	106	213.7	469.1
	Cobalt	mg/kg	26	26	18.3	73.8	34	30.6	15	39.62	78.72
	Copper	mg/kg	26	26	68.2	3970	1149	601	1162	1745	10674
	Iron	mg/kg	26	26	37500	199000	92119	72550	55847	116075	286824
	Lead	mg/kg	26	26	46.2	1820	560	413	547	826.2	4425
	Mercury	mg/kg	26	26	0.31	4.19	1.3	0.7185	1.1	1.795	5.564
	Molybdenum	mg/kg	26	25	<0.628	42.7	13	6.61	13	19.12	117.7
	Nickel	mg/kg	26	26	98.7	705	282	184.5	208	366.4	1073
	Selenium	mg/kg	26	10	0.56	4.3	1.3	1.015	0.85	1.692	3.271
	Silver	mg/kg	26	26	0.345	6	1.8	1.24	1.7	2.494	9.253
	Thallium	mg/kg	26	2	0.922	1.13	0.88	0.86	0.17	NC	NC
	Vanadium	mg/kg	26	26	44.2	97.8	69	68.85	13	73.42	98.53
	Zinc	mg/kg	26	26	232	28500	4847	2505	6797	7579	40447
PCBs	Total PCBs	µg/kg	26	26	153	7760	2416	1670	2257	3496	18507

Notes:
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Metals = Title 22 Metals, aluminum, iron
NC = not calculated
PCB = polychlorinated biphenyls
St Dev = standard deviation
UCL = upper confidence limit
UTL = upper tolerance limit
95% UCL = 95-percent upper confidence limit on the mean
95% UTL = 95-percent upper tolerance limit on the mean
UCL calculated using ProUCL 5.0.00 Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations

Table A-2
Statistical Evaluation – Project Area, Subtidal Locations
Sediment Investigation Report
Sims Metal Management, Redwood City, California

			Number Samples	Number Detects	Min	Max	Mean	Median	St Dev	95% UCL Concentration	95% UTL Concentration
Metals	Aluminum	mg/kg	104	104	12500	37100	24981	24550	4508	25715	33625
	Antimony	mg/kg	104	37	0.333	93.1	3.1	0.9	11.0	5.066	23.39
	Arsenic	mg/kg	104	104	6.02	76	14	12.3	10	16.22	34.28
	Barium	mg/kg	104	104	40.7	1290	139	80.4	180	216	484.8
	Beryllium	mg/kg	104	101	0.335	0.819	0.64	0.6365	0.095	0.654	0.811
	Cadmium	mg/kg	104	98	0.502	103	4.5	1.48	12	9.475	26.51
	Chromium	mg/kg	104	104	78.5	780	131	107	91	146.4	305.7
	Cobalt	mg/kg	104	104	12.6	317	25	19.8	30	30.55	83.43
	Copper	mg/kg	104	104	32.9	12000	422	80.25	1291	973.8	2898
	Iron	mg/kg	104	104	34200	186000	53460	42850	27529	58072	106244
	Lead	mg/kg	104	104	11.1	3080	200	65.85	430	383.3	1024
	Mercury	mg/kg	104	103	0.0613	16.6	1.1	0.5505	2	1.965	4.922
	Molybdenum	mg/kg	104	59	0.289	56.7	3.4	0.413	7.8	6.773	18.31
	Nickel	mg/kg	104	104	79.8	3520	187	109	356	339.1	869.6
	Selenium	mg/kg	104	40	0.753	10.9	1.7	0.985	1.9	2.127	5.364
	Silver	mg/kg	104	81	0.189	47.8	1.5	0.688	4.8	2.43	10.68
	Thallium	mg/kg	104	2	0.512	0.576	0.89	0.835	0.2	NC	NC
	Vanadium	mg/kg	104	104	52.4	101	75	74.8	8.2	76.13	90.6
	Zinc	mg/kg	104	104	88	10100	829	249	1539	1487	3780
PCBs	Total PCBs	µg/kg	104	93	37	12000	916	225	1896	1728	4533

Notes:
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
Metals = Title 22 Metals, aluminum, iron
NC = not calculated
PCB = polychlorinated biphenyls
St Dev = standard deviation
UCL = upper confidence limit
95% UCL = 95-percent upper confidence limit on the mean
UCL calculated using ProUCL 5.0.00 Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations

APPENDIX B

ECOLOGICAL RISK ASSESSMENT,
WINDWARD ENVIRONMENTAL LLC, OCTOBER 16, 2018

REVISED DRAFT

REVISED ECOLOGICAL RISK ASSESSMENT FOR THE PORT OF REDWOOD CITY WHARF 3 AREA SIMS METAL MANAGEMENT

Prepared for

Sims Group USA Corporation

October 16, 2018

Prepared by: Windward environmental LLC

200 West Mercer Street, Suite 401 • Seattle, Washington • 98119

This page intentionally left blank.

Table of Contents

Tables

Figures

Acronyms

BAF	biota accumulation factors
BAZ	biologically active zone
BTAG	Biological Technical Assistance Group
BW or bw	body weight
COC	constituent of concern
CSM	conceptual site model
dw	dry weight
Eco-SSL	ecological soil screening level
EPA	US Environmental Protection Agency
ERA	ecological risk assessment
ERM	effects range – median
ERMq	effects range – median quotient
FIR	food ingestion rate
HQ	hazard quotient
LOAEL	lowest-observed-adverse-effect level
MLLW	mean lower low water
NOAEL	no-observed-adverse-effect level
NWR	National Wildlife Refuge
PCB	polychlorinated biphenyl
Port	Port of Redwood City
Sims	Sims Group USA Corporation
SIR	sediment ingestion rate
SRP	sediment remediation plan
SUF	site use factor
Terraphase	Terraphase Engineering Inc.
TRV	toxicity reference value
Windward	Windward Environmental LLC

This page intentionally left blank.

1 Introduction

On behalf of the Sims Group USA Corporation (Sims)—and in accordance with the Consent Decree between the United States Environmental Protection Agency (EPA) and Sims, Case 3:14-cv-04209, dated September 15, 2014 (N. D. Ca. C14-4209), and effective December 1, 2014 (the "Consent Decree"(US District Court 2014))—Windward Environmental LLC (Windward) has prepared this ecological risk assessment (ERA) in accordance with applicable risk assessment guidance and policies (EPA 1997, 1998; California DTSC 1996). This ERA takes into consideration comments provided by EPA during a meeting with Sims on July 18, 2018, and has been developed for both baseline and residual conditions assuming remediation of sampling locations with the highest constituent concentrations, as identified by EPA.

This evaluation addresses sediments in the immediate vicinity of Wharf 3 at the Port of Redwood City, a stretch that is composed of a riprap area and a subtidal area. Both the riprap and subtidal areas are in an industrial waterway and are subject to current and future industrial use. The area evaluated by this ERA (hereafter referred to as the Project Area) is approximately 100 ft wide by approximately 325 ft long.

The goals of this evaluation are:

- Develop an ecological conceptual site model (CSM) of the riprap and subtidal areas.
- Evaluate the potential for exposure of ecological receptors to constituents under baseline conditions and conditions that would exist upon implementation of the remedial alternatives described in the Sediment Remediation Plan, and compare the potential exposure to effects thresholds to characterize potential risks.
- Use, to the extent possible, ERA analyses similar to those used in the San Francisco Bay area as a basis for assumptions or receptors.

The remainder of this ERA is organized as follows, consistent with appropriate guidance:

- Section 2 presents the site description and environmental setting.
- Section 3 presents the ecological CSM.
- Section 4 presents the wildlife exposure and effects assumptions used for risk characterization.
- Section 5 presents the baseline and residual wildlife risk characterization and uncertainty assessment.
- Section 6 summarizes the ERA conclusions.
- Section 7 presents references.

Data and methods from another industrial site in San Francisco Bay, the Yosemite Slough, were used to inform the methods and assumptions for this assessment. The Yosemite Slough site (EPA and E&E 2013) addressed polychlorinated biphenyls (PCBs) and metals in sediment and receptors similar to those in the Project Area, so the methods and assumptions used in the development of EPA-approved ecological assessments for that site are used herein.[1]

[1] The Yosemite Slough site methods and assumptions were, in turn, based on the approach used at the adjacent Parcel F (offshore sediments) of the Hunters Point Shipyard site (Battelle et al. 2005).

2 Site Description and Environmental Setting

2.1 General Setting and Habitat

As described in detail in the final Sediment Investigation Report (Terraphase 2018), Sims operates a metal-recycling facility (hereafter referred to as the Sims Facility) located at the Port of Redwood City (Port) in San Mateo County, California. The Project Area—which is adjacent to the Sims Facility and encompasses both subtidal and riprap/intertidal estuarine sediments (Figure 2-1)—represents a small area within Redwood Creek along an active industrial waterfront. Redwood Creek is part of San Francisco Bay and is used for many purposes, including: industrial, waterfront residential, marina, recreational, open space, and institutional uses (EKI 2016). Port facilities along the eastern shoreline of Redwood Creek include several shiploading wharves, docks, and piers. However, the Project Area is an industrial use area and is expected to remain so in the future. Redwood Creek is dredged on a regular basis to maintain the navigation channel of -30 ft mean lower low water (MLLW) to allow for large vessel access at the wharves (ESA 2017).

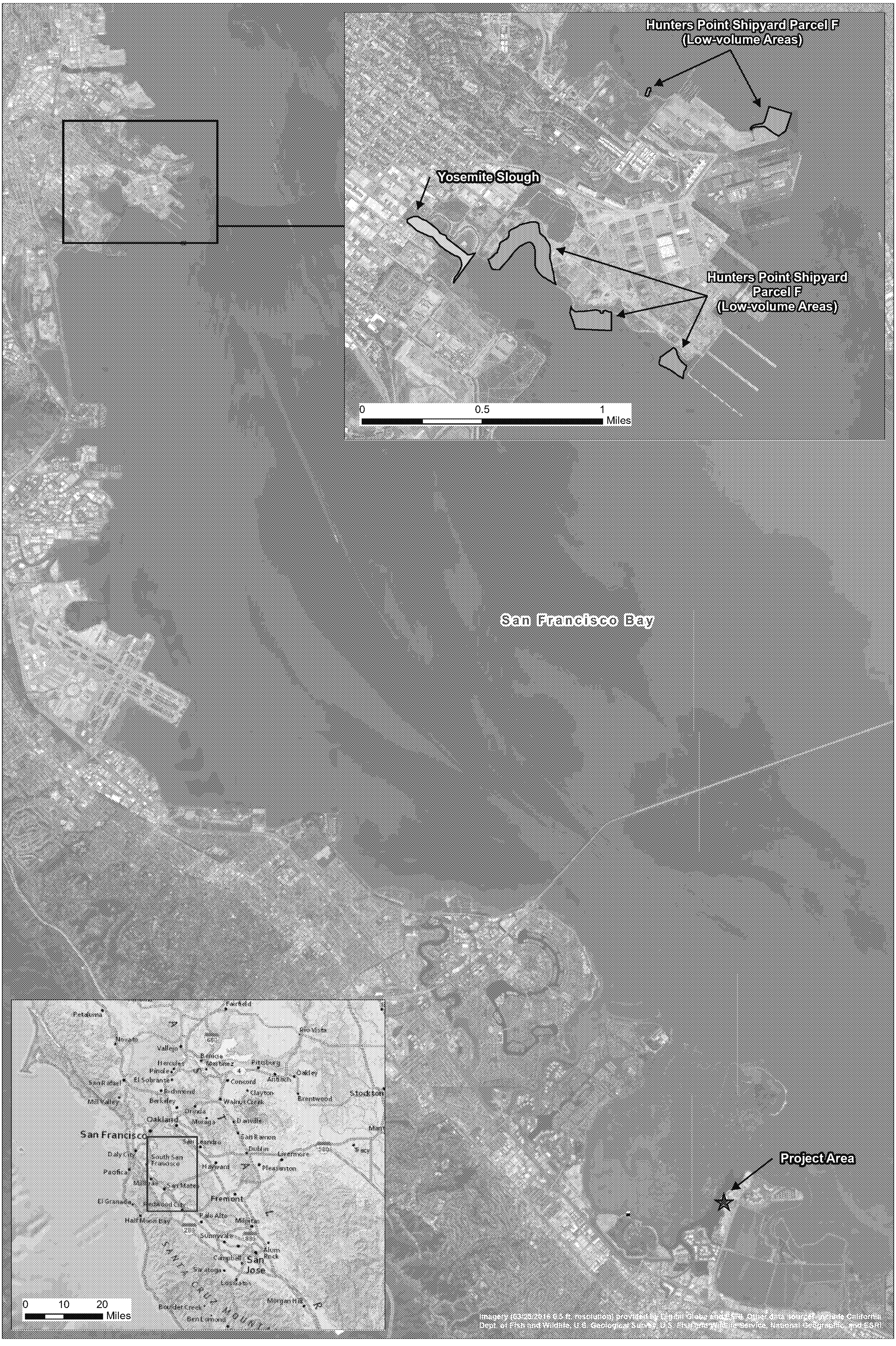
Windward environmental LLC

Figure 2-1. Project Area

REVISED DRAFT

Prepared by mikey, 2/28/2018; W:\Projects\Sims Group\Data\GIS\Maps and Analyses\ERA\Fig 2-1 6750_Project Area.mxd

The Project Area is a very small area, measuring approximately 0.6 acres, landward of Wharf 3 (Figure 2-1). It should be noted that the Project Area is much smaller than both the Yosemite Slough site (approximately 9 acres) (EPA and E&E 2013) and Parcel F (i.e., low-volume footprint areas) of the Hunters Point Shipyard site (approximately 42 acres) (Battelle et al. 2005) (Figure 2-2). The 0.6-acre Project Area is also quite small relative to nearby habitat, representing less than 1% of the intertidal and subtidal areas of Redwood Creek (approximately 239 acres) (Figure 2-3).



Prepared by mikey, 2/28/2018; W:\Projects\Sims Group\Data\GIS\Maps and Analyses\ERA\Fig 2-2_6743_Project Area and vicinity.mxd

Windward environmental LLC

Figure 2-2. Project Area and vicinity

REVISED DRAFT

This page intentionally left blank.

Name	Acres
Greco Island	786.2
Bair Island Ecological Reserve	1,931.8
Steinberger Slough	304.8
Redwood Creek	239.0
Project Area	0.6

Windward environmental LLC

Figure 2-3. Project area and adjacent intertidal/subtidal habitat

REVISED DRAFT

Prepared by mikey, 2/28/2018; W:\Projects\Sims Group\Data\GIS\Maps and Analyses\ERA\Fig 2-3_6749_Project Area and adjacent intertidal_subtidal habitat.mxd

For purposes of the ERA, the Project Area is divided into two exposure evaluation units: the riprap unit (lower and upper riprap), and the lower riprap/subtidal unit (Figure 2-1). The differentiating characteristic between the units is how accessible they are to potential foraging wildlife receptors; consequently, the two units are considered separately. Basic unit descriptions are as follows:

- The riprap unit is covered by large rocks, which limit physical access to the underlying sediments. The lower portion of the riprap-covered slope has rock covering that is less dense (with more exposed sediment) than in the uppermost riprap area.
- The lower riprap/subtidal unit consists of the lower portion of the riprap-covered slope and the subtidal sediment.

These exposure areas are discussed in more detail under the CSM description (Section 3).

2.2 POTENTIAL ECOLOGICAL HABITAT IN PROJECT AREA AND VICINITY

Information regarding the potential ecological habitat within the Project Area is important to understand in the development of the site-specific ecological CSM (Section 3). The Project Area does not support high-quality wildlife habitat due to its current industrial uses (ESA 2017). The Port described the habitat as industrial in its environmental description of the Project Area that was prepared in connection with a fender replacement project. As stated in the Port's permit application, the Project Area is designated Industrial Port-Related by the City of Redwood City general plan and is zoned General Industrial (ESA 2017). Any previously existing tidal flats, typically used by foraging birds, have been removed to make room for current industrial uses (ESA 2017). The abundance and diversity of fish, aquatic organisms, and wildlife is less than in the nearby Bair Island Ecological Reserve and Don Edwards San Francisco Bay National Wildlife Refuge (NWR) (Figure 2-3) (ESA 2017).

2.2.1 Project Area

Aquatic habitat types in the vicinity of the Project Area include shallow bay and subtidal (channel), tidal flat, and rocky shore (riprap) areas (ESA 2017). While tidal flats are not present in the Project Area, having been replaced with shoreline structures or removed by channel dredging within Redwood Creek, this habitat type does occur northwest of the Project Area in the Don Edwards San Francisco Bay NWR (ESA 2017).

The sediments in the subtidal area are generally composed of clay and silts and support the presence of a benthic invertebrate community (ESA 2017). Rocky riprap is present along the reinforced shoreline of the Project Area. While riprap may provide some habitat to epibenthic organisms, such as mussels (*Mytilus* sp.), barnacles, and rock crabs (*Cancer antennarius and C. productus*) (ESA 2017), a robust infaunal benthic community is not expected to be present and available as prey, given the isolated nature of the pockets of sediment.

Figures 2-4a through 2-4c show the general shoreline along the Project Area.

Figure 2-4a. Redwood Creek Project Area Photo A

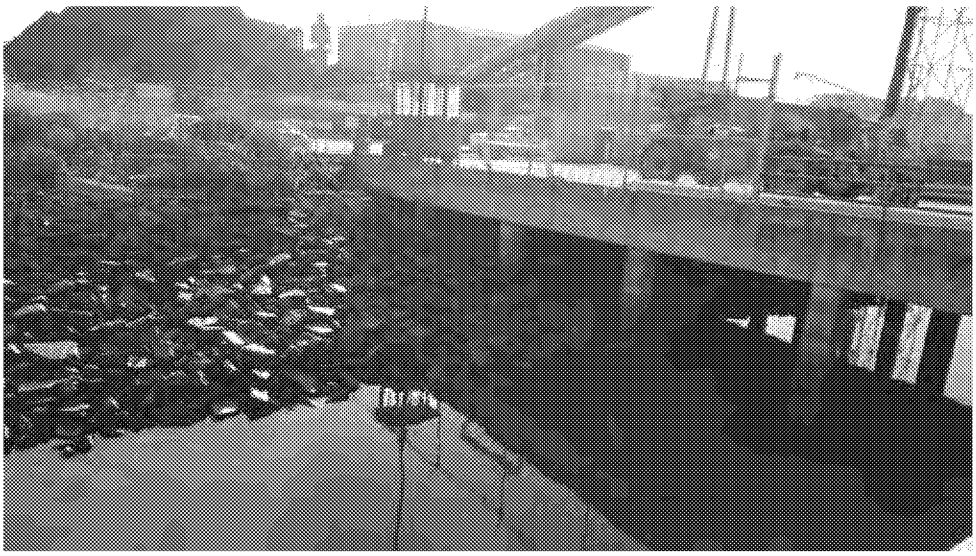


Figure 2-4b. Redwood Creek Project Area Photo B

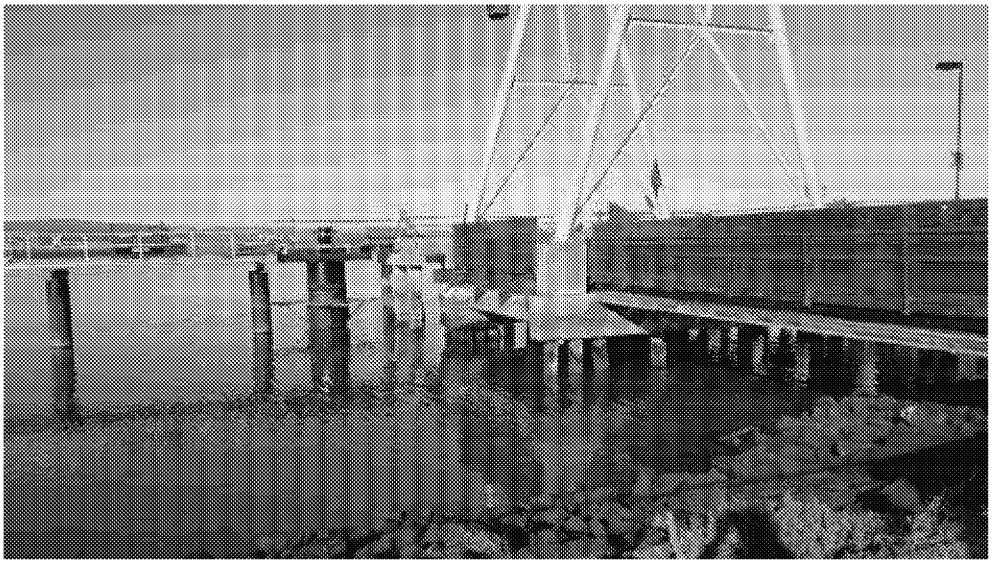


Figure 2-4c. Redwood Creek Project Area Photo C

2.2.2 Nearby habitat

The size of the Project Area relative to that of the intertidal marsh habitat areas on nearby Bair and Greco Islands is less than 0.1%. Bair Island is actually three islands (Inner, Middle, and Outer) totaling approximately 3,200 acres (Figure 2-3). Historically, Bair Island was used for salt evaporation ponds, but the ponds were drained in 1965. Since 1986, a portion of Bair Island has been designated as an ecological reserve (CDFW 2017). Approximately 2,000 acres of Middle and Outer Islands are within the Bair Island Ecological Reserve, and approximately 1,000 acres are part of the larger Don Edwards San Francisco Bay NWR. A restoration plan that was completed in 2006 has been implemented to restore Bair Island to intertidal salt marsh habitat (USFWS 2006, 2012).

Greco Island, located northeast of the Project Area, is approximately 800 acres and consists of intertidal marsh habitat (Figure 2-3). Nearly half of Greco Island was developed into salt works in the early 1900s. By the late 1950s, all of the historical salt works had reverted to intertidal marsh (USFWS 2012). The bay side of Greco Island contains the largest area of relatively undisturbed historical intertidal marsh in the southern portion of San Francisco Bay (USFWS 2012).

The habitat areas around Bair and Greco Islands are composed of more desirable foraging habitat for wildlife than that available within the limited footprint of the industrial Project Area.

This page intentionally left blank.

3 Ecological Conceptual Model

The following section presents the overall ecological CSM for the Project Area. As noted, ecological evaluations completed for nearby, larger but similar (albeit less industrial than the Port of Redwood City) sites (Yosemite Creek and Hunters Point Shipyard) were consulted to ascertain if similar receptors and exposure pathways could be used for this ERA. Site-specific information on habitat quality and quantity was derived from available site-specific studies (EKI 2016; ESA 2017).

The CSM is critical in the development and selection of relevant receptors and exposure pathways for an appropriate risk evaluation (EPA 1997, 1998; California DTSC 1996). For this ERA, the CSM was used to determine whether constituents in the sediment could adversely impact potential ecological receptors via complete exposure pathways.

3.1 Potential Ecological Receptors

Wildlife species utilizing the Project Area are expected to be similar to those noted in the Yosemite Slough site ERA (EPA and E&E 2013); however, the Project Area has more freshwater influence and no significant emergent vegetation. While limited in the Project Area, it and the vicinity within Redwood Creek do provide wildlife habitat for some species, including: western grebe (*Aechmophorus occidentalis*), canvasback (*Aythya valisineria*), surf scoter (*Melanitta perspicillata*), ruddy duck (*Oxyura jamaicensis*), and Forster's tern (*Sterna forsteri*). Some mammals, such as harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*), may be present in the vicinity of the Project Area (EKI 2016; ESA 2017), but use of the Project Area by wildlife is quite limited relative to other areas in and near Redwood Creek. No significant use by threatened and endangered wildlife species has been found at the Project Area (ESA 2017).

A limited benthic community is expected in the subtidal surface sediment of the Project Area and, to some extent, in the lower riprap sediment. The Project Area is within the mesohaline environment of San Francisco Bay (Thompson et al. 2013), and the benthic community within the Project Area is expected to be consistent with those in other locations within the mesohaline environment. Mesohaline benthic communities are primarily represented by amphipods, polychaetes, oligochaetes, and bivalves, taxa that represent different feeding strategies (Table 1) (Nichols and Thompson 1985; Thompson et al. 2013). The most common benthic taxa are the amphipods *Ampelisca abdita* and *Monocorphium acherusicum*, the polychaete *Streblospio benedicti*, the bivalves *Potamocorbula amurensis* and *Gemma gemma*, and the oligochaetes *Tubificid sp.* (Thompson et al. 2013). Because Redwood Creek is an active shipping channel and the Project Area is industrial, the benthic community is not expected to be as robust as would be expected in a non-industrial area.

Table 3-1. Representative taxa found in San Francisco Bay mesohaline environments

Taxa Group	Representative Species	Feeding Strategy
Amphipods	*Ampelisca abdita, Monocorophium acherusicum, Grandidierella japonica, Corophium spp.*	tube-dwelling filter feeders, surface-feeding detritivore
Polychaetes	*Streblospia benedicti, Heteromastus filiformis, Glycinde sp., Asychis elongate, Polydora sp.*	surface-feeding detritivore, filter feeders
Oligochaetes	*Tubificidae sp.*	head-down deposit feeders
Bivalves	*Potamocorbula amurensis, Corbula amurensis, Gemma gemma, Macoma balthica, Mya arenaria*	surface filter feeders

Sources: Thompson et al. (2013); Nichols and Thompson (1985); Nichols and Pamatmat (1988); EPA (2015).

3.2 Sediment Exposure Depth

Given the feeding mode of most of the benthic invertebrates that are representative of mesohaline benthic communities in San Francisco Bay, it is expected that the biologically active zone (BAZ) is limited largely to the upper few centimeters of the sediment surface where these representative species live. That the majority of the benthic community resides in the upper few centimeters is not uncommon. De La Cruz et al. (2017), in their study of the density of benthic invertebrate communities based on depth from the sediment surface, found that the majority of benthic invertebrates are located in the upper 2 cm. The authors observed that most of the benthic species were found at a shallow depth, regardless of whether the benthic community was undisturbed (stable environment) or was recovering from disturbance (following a dredging event). These observations are similar to the guidance provided by EPA (2015) on determining the appropriate depth of sediment to use when conducting ERAs. EPA recommends that a risk assessment be conducted on sediment collected to a depth that represents the 80th percentile distribution of the abundance of the benthic community at the site. Using the information provided in Figure 3 of the guidance document (EPA 2015), the mean depth expected for the mesohaline benthic community found at Redwood Creek is between approximately 5 and 7 cm (for mesohaline mud and mixed mud and sand substrates, respectively). Biomass that is present deeper than 15 cm is expected to be mostly a low density of bivalves that filter feed at the surface, limiting their exposure to deep sediments. Accordingly, surface sediment collected from 0 to -15 cm (0.0 to -0.5 ft) was used to evaluate the potential exposure of ecological receptors. While there are sediments at depth (below the BAZ) with elevated constituent concentrations (Terraphase 2018), benthic invertebrate community exposure to sediments below 15 cm is not expected.

3.3 Potential Ecological Exposure Pathways

As described, based on the potential for ecological exposure, the Project Area sediment is divided into two units for the ecological CSM: the lower riprap/subtidal unit and the riprap unit (Figure 3-1). Whereas surface sediments in the riprap unit are available only between the substrate (rocks), surface sediments are readily available for exposure in the subtidal unit. The lower riprap is included in both the lower riprap/subtidal unit and the riprap unit. The lower riprap has more spaces between the rocks (i.e., exposed sediment) than does the upper riprap, resulting in an increased potential for exposure to ecological receptors compared to the upper riprap. The potential for ecological receptors to be exposed to sediment in each of these units is as follows:

- **Lower riprap/subtidal unit sediment** – Diving ducks or other avian species have the potential, albeit infrequently, to be exposed to subtidal sediment and riprap sediment within the lower portion of the riprap area when it is inundated; exposure could occur either directly or indirectly through the consumption of benthic prey present in the sediment.
- **Riprap (lower and upper) unit sediment** – Based on the information provided by ESA (2017), this rocky riprap is considered an exposure barrier for the majority of ecological receptors that use sediment for probing or foraging. Wading birds have the potential, albeit infrequently, to be exposed to sediments between the rocks in the riprap area. Exposure could occur either directly or indirectly through the consumption of benthic prey present in the sediment. Exposure in the upper riprap area is considered limited because of the dense rock cover. In addition, the lower riprap has more exposed sediment than in the upper riprap, resulting in an increased potential for exposure to wading birds and benthic organisms.

Figure 3-2 presents the ecological CSM for the Project Area, including the potential ecological exposure pathways. This assessment focuses on the potential exposure of ecological receptors to surface sediment. As discussed in Section 3.2, exposure to surface sediment is limited to the BAZ, which is expected to exist within the top 15 cm of sediment only.

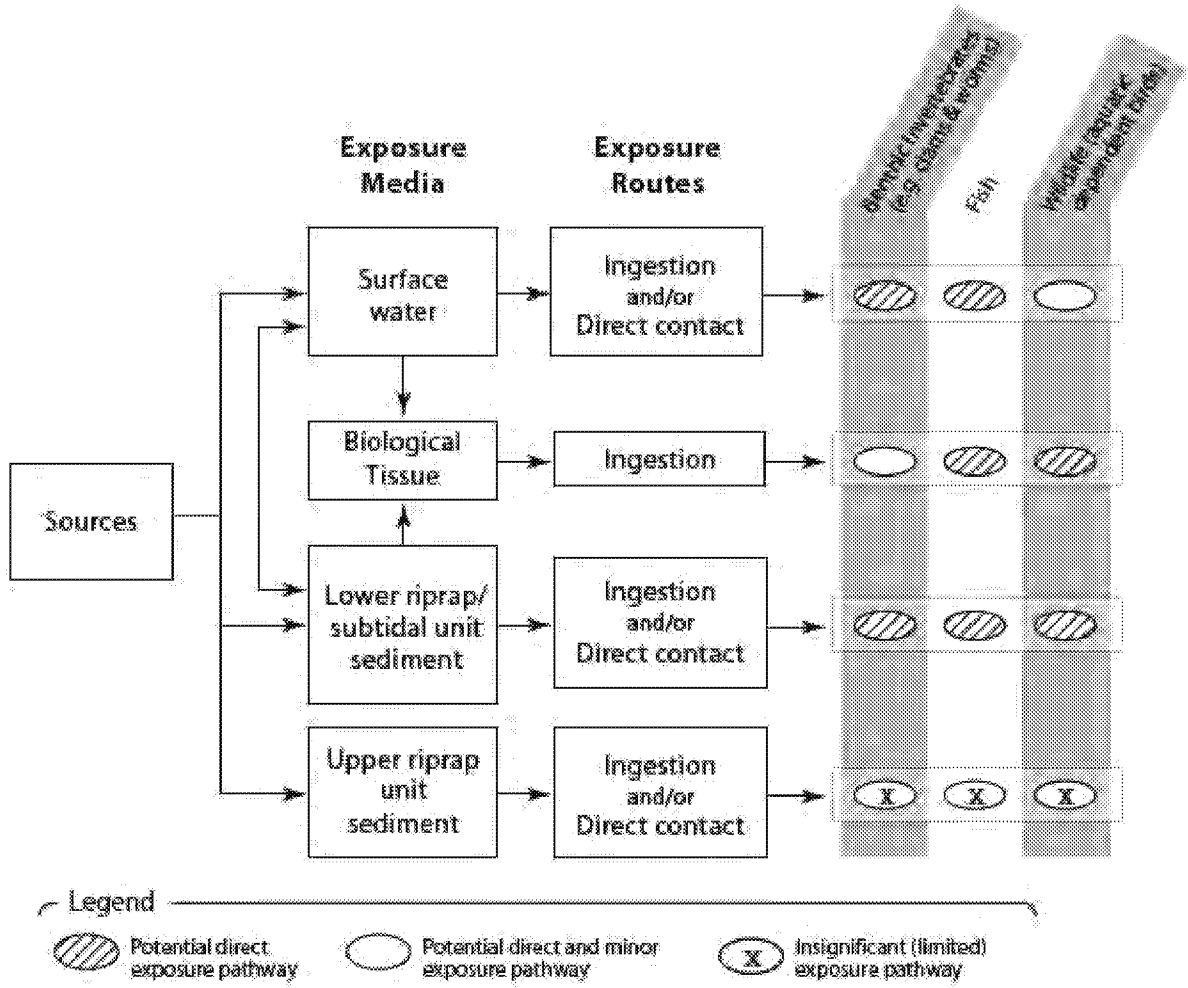
N
0 20 40 Feet
0 10 20 Meters

Windward environmental LLC

Figure 3-1. Sediment sample locations in the ecological exposure area

REVISED DRAFT

Prepared by mikey, 9/28/2018; W:\Projects\Sims Group\Data\GIS\Maps and Analyses\ERA\Fig 3-1_6745_Sediment sample locations at Project Area.mxd



Note: Subtidal sediment exposure was evaluated with the lower riprap because the subtidal sediment is more accessible to ecological receptors than the sediment in the lower riprap. The upper riprap sediment was included when evaluating benthic prey exposure for wading birds, but was not included when evaluating the direct exposure to benthic invertebrates (Attachment A) given the limited exposure pathway.

Figure 3-2. Ecological conceptual site model

3.4 Selected Ecological Receptors

The specific ecological receptors selected for evaluation in this ERA represent maximum exposure scenarios, consistent with ERA guidance (EPA 1997; California DTSC 1996).

3.4.1 Benthic invertebrates

The benthic invertebrate community is not expected to be as robust as that in a non-industrial area, as described. However, there may be a possibility of wildlife exposure to benthic organisms via the food chain, the evaluation of which is presented in Section 4. Because EPA voiced concern during the July 18, 2018, meeting regarding the exposure of wildlife receptors to pockets of sediment in the upper riprap that may contain invertebrate prey, an evaluation of risk from the ingestion of invertebrate prey in the upper and lower riprap was conducted for completeness.

For the lower riprap/subtidal exposure area, the benthic community evaluation is presented in Attachment A. While the benthic invertebrate community is not expected to be as robust as that in a non-industrial area, the risk to benthos was evaluated as part of the baseline and remedial alternatives analyses. Details on the benthic invertebrate community expected to be present are discussed in Section 3.1.

3.4.2 Wildlife

Lesser scaup (*Aythya affinis*) were selected as a representative benthic invertebrate-eating, site-specific wildlife receptor for the subtidal/lower riprap area. The exposure pathway for the species represents a maximum exposure scenario, based on its feeding strategy and prey availability within the larger San Francisco Bay area. Scaup in San Francisco Bay have adapted to feed primarily on the highly abundant clam *P. amurensis* (Poulton et al. 2002), which is expected to be present in the mesohaline mud subtidal habitats at and near the Project Area (Thompson et al. 2013). Scaup are considered more representative of benthic invertebrate-eating aquatic birds than are surf scoter (the benthic invertebrate-eating receptors selected for Hunters Point Shipyard site), because previous bird surveys conducted near the Project Area have indicated that scoter are uncommon in the vicinity (Richmond et al. 2014). Although surf scoter could be present in the area in the winter, their presence would be limited to the open-water areas of San Francisco Bay (i.e., outside of Redwood Creek) (Richmond et al. 2014). In addition, surf scoter have been shown to respond to ephemerally abundant food sources, like herring spawn or polychaete worms, making them less appropriate to represent benthic invertebrate-eating receptors (Lacroix et al. 2005).

Lesser scaup, consistent with EPA guidance (EPA 1997, 1998; California DTSC 1996), represent the maximally exposed receptor for the subtidal area. Therefore, as is typical in the problem formulation phase of an ERA, the species is considered representative of other ecological receptors in the subtidal area (such as those listed in Section 3.1). Scaup were selected rather than other duck species potentially present in the subtidal area, such as a canvasback, because such species are more omnivorous (i.e., eat both plants and invertebrates); since plants are very limited in the Project Area, the exposure of lesser scaup, which consumes primarily invertebrates, is expected to be greater.

Great blue heron were identified as a potential benthic invertebrate-eating wildlife receptor for the riprap (upper and lower riprap) area. Great blue heron serve as a representative wading bird that is most often observed in shoreline habitat. Fish are the preferred prey of great blue heron (EPA 1993), but they also feed opportunistically on a variety of organisms, including small mammals, reptiles, amphibians, insects, and crustaceans (Kushlan 1978; Butler 1993). Great blue heron are abundant throughout most of North America; there are both migratory and non-migratory populations. In general, in the winter, great blue heron move south from their breeding areas in North America.

The exposure of fish-eating birds is expected to be less than that of invertebrate-eating birds; fish are exposed to sediment over a much larger region than just the Project Area, and the range of fish-eating birds is substantially greater than the Project Area (e.g., foraging range of double-crested cormorants [*Phalacrocorax auritus*] nesting at the San Francisco-Oakland Bay Bridge estimated as approximately 56,100 acres (Battelle et al. 2005)). Therefore, birds that exclusively eat fish were not considered in this assessment.

This page intentionally left blank.

4 Wildlife Exposure and Effects Evaluation

The analysis of exposure and effects prior to risk characterization is consistent with ERA guidance (EPA 1997, 1998; California DTSC 1996). As stated, this ERA focuses on the maximum exposure scenario and receptor(s) and attempts to be consistent with other proximal ERAs with similar scenarios, receptors, and constituents. Since the Yosemite Slough site and its receptors, pathways, and constituents were similar to those of the Project Area, and the risk assessment for that site was completed and accepted by regulatory authorities (EPA and E&E 2013), the Yosemite Slough site was used as a basis for the Redwood City ERA. The derivation of assumptions and methods for the Yosemite Slough site was documented in the *Hunters Point Shipyard Parcel F Validation Study Report* (Battelle et al. 2005). For consistency, a similar method was adopted to evaluate the Project Area and is documented in the following subsections:

- Section 4.1 – Identifies the constituents evaluated (constituents of concern [COCs])
- Section 4.2 – Identifies the dietary exposure assumptions and biota accumulation factors (BAFs) used to model prey tissue
- Section 4.3 – Identifies the toxicity reference values (TRVs) for COCs

4.1 COCs Evaluated

Project Area sediment was characterized by determining concentrations of metals and PCBs, using values presented in the final Sediment Investigation Report (Terraphase 2018). The dataset included data from surface (0 to -15 cm) sediment samples, which were collected from 35 locations in the subtidal unit, 13 locations in the lower riprap, and 16 locations in the upper riprap. As stated, the subtidal unit was evaluated with the lower riprap, and the riprap unit included the lower and upper riprap areas.

Metals that were detected infrequently, such as selenium and thallium (Terraphase 2018), were not included in this ERA (Table 5-1). In addition, the following metals were not evaluated because the forms of these elemental and essential metals available in the environment are not expected to be toxic to ecological receptors: aluminum, barium, and iron.

4.2 Exposure Assessment

In the exposure assessment, dietary doses for scaup and great blue heron based on exposure within the lower riprap/subtidal unit, respectively, were estimated based on ingestion of biota (i.e., prey) and incidental ingestion of sediment. Dietary doses were estimated as milligrams of each constituent ingested per kilograms of body weight per day (mg/kg bw/day) using the following equation:

$$Dose = \frac{\left[\left(FIR \times C_{prey}\right) + \left(SIR \times C_{sed}\right)\right]}{BW} \times SUF$$

Equation 4-1

Where:

- Dose = daily ingested dose (mg/kg bw/day)
- FIR = food ingestion rate (kg ww/day)
- C_{prey} = concentration in prey tissue (mg/kg ww); C_{prey} was estimated using C_{sed} and BAFs
- SIR = incidental sediment ingestion rate (kg dw/day)
- C_{sed} = concentration in lower riprap/subtidal unit surface (0–0.5 ft) sediment (mg/kg dw), represented by the 95 UCL[2]
- BW = body weight (kg)
- SUF = site use factor (unitless)

Exposure assumptions and BAFs used to model prey tissue concentrations are presented in the following subsections.

4.2.1 Exposure assumptions

The selected body weights, ingestion rates, and dietary compositions of lesser scaup and great blue heron are presented in Table 4-1. These parameters are discussed in detail in the following subsections.

Table 4-1. Summary of bird exposure parameter assumptions

Exposure Parameter	Lesser Scaup		Great Blue Heron	
	Value	Source	Value	Source
Body weight (kg)	0.815	EPA (1993)	2.3	EPA (1993)
FIR (kg/d dw)	0.0629	Nagy (2001)	0.018	EPA (1993)
SIR (kg/d dw)	0.0030	4.7% FIR (Beyer et al. 2008)	0.0017	conservative assumption of 2% of FIR
Diet	100% invertebrates	EPA (1993); Anteau et al. (2014)	100% invertebrates	conservative assumption to evaluate riprap exposure area with available data
Foraging range	220 acres	EPA (1993)	1.4 (fall) to 20 acres (winter)	EPA (1993)
SUF	0.5	conservative assumption	0.5	conservative assumption

EPA – US Environmental Protection Agency
FIR – food ingestion rate
SIR – sediment ingestion rate
SUF – site use factor

[2] Upper confidence limit (UCL) concentrations used to represent exposure point concentrations (EPCs) were calculated using EPA's ProUCL® statistical package (Version 5.1.00) (EPA 2016) and were derived following EPA guidance for calculating UCLs for EPCs at hazardous waste sites (EPA 2002).

4.2.1.1 Body weight

The lesser scaup's body weight of 0.815 kg was based on the average male and female data reported for the United States in EPA's *Wildlife Exposure Factors Handbook* (EPA 1993).

4.2.1.2 Food ingestion rate

A food ingestion rate (FIR) of 0.0629 kg dry weight (dw)/day for the lesser scaup was based on the allometric equation derived for all birds (Nagy 2001), wherein:

$$FIR = 0.638 \times BW^{0.685} \qquad \textbf{Equation 4-2}$$

Where:

FIR	=	food ingestion rate (kg dw/day)
BW	=	body weight (g)

A FIR of 0.018 kg dw/day for great blue heron was based on the average adult male and female data reported by Kushlan (1978), as cited by EPA (1993).

4.2.1.3 Sediment ingestion rate

For lesser scaup, an incidental sediment ingestion rate (SIR) of 0.0063 kg dw/day was derived by assuming that the species incidentally ingested sediment at up to 4.7% of its FIR. This assumption was based on an incidental SIR for lesser scaup reported by Beyer et al. (2008).

For great blue heron, an incidental SIR of 0.0017 kg dw/day was derived by assuming that the species incidentally ingested sediment at up to 2% of its FIR.

4.2.1.4 Diet

While the diet of lesser scaup is predominately aquatic benthic invertebrates such as insects, crustaceans, and mollusks, scaup may also consume some portion of vegetation and fish (EPA 1993; Anteau et al. 2014). Fish are the preferred prey of great blue heron (EPA 1993), but they also feed opportunistically on a variety of organisms, including small mammals, reptiles, amphibians, insects, and crustaceans (Kushlan 1978; Butler 1993). For modeling, 100% ingestion of benthic invertebrates was assumed for this assessment for both receptors, thereby limiting the species' potential for exposure to location-specific sediment (since benthic invertebrates are immobile or have very limited mobility compared to fish, and the presence of vegetation is generally lacking).

4.2.1.5 Site use factor

It is critical to establish a reasonable site use factor (SUF) for selected ecological receptors to accurately characterize their potential exposure at a given site. It is especially critical at the Project Area, given the very small size of the site. The home range, particularly the foraging areas within the home range, and movement patterns of a species, are important in determining whether exposure areas are representative of actual exposure (EPA 1998). Several factors can be considered when determining an appropriate SUF:

- Foraging range/home range of receptor – EPA (1993) cites a mean minimum foraging home range of 220 acres for lesser scaup and 1.4 to 20 ac for great blue heron.
- Area of the site relative to nearby similar- or higher-quality habitat – The Project Area represents a small footprint of ecological habitat within the home range of scaup, which also includes other portions of Redwood Creek and nearby high-quality habitats at Bair and Greco Islands and Stienberger Slough (Figure 2-3).

Table 4-2 summarizes the size of the Project Area relative to the home range reported for lesser scaup and great blue heron and relative to nearby intertidal and subtidal habitat and potential SUFs based on these values. Also important to note is the relative size of the Project Area (0.6 ac) compared to the Hunters Point Shipyard site (i.e., the defined "low-volume footprint areas" totaling 42 ac) (Figure 2-2) (Battelle et al. 2005); the Project Area is 1% of the area of the Hunters Point Shipyard site.

Table 4-2. Summary of spatial areas used in determining the SUF

Area	Size (acres)	Potential SUF	Notes
Project Area	0.6	na	na
Lesser scaup home range (EPA 1993)	220	0.003	size of Project Area (0.6 ac) divided by size of lesser scaup home range (220 ac)
Great blue heron home range (EPA 1993)	1.4–20	0.4–0.03	size of Project Area (0.6 ac) divided by size of great blue heron home range (1.4 to 20 ac)
Redwood Creek subtidal/intertidal area (Battelle et al. 2005)	239	0.002–0.0003	size of Project Area (0.6 ac) divided by size of individual nearby habitat areas
Steinberger Slough subtidal/intertidal area	305		
Nearby intertidal habitat – Bair Island Ecological Reserve	1,932		
Nearby intertidal habitat – Greco Island	768		

na – not applicable
SUF – site use factor

Based on the information presented in Table 4-2, an SUF for lesser scaup of 0.003 or less and 0.4 or less for great blue heron is appropriately reasonable. To be conservative, a SUF of 0.5 was used in the risk evaluation for lesser scaup and great blue heron. An SUF of 0.5 assumes that lesser scaup and great blue heron will spend 50% of their time in the Project Area. Given the very small size of the Project Area (0.6 acres), this is a very conservative assumption. Further, lesser scaup are migratory and are not present in the region year-round; the species overwinters in San Francisco Bay and leaves the area to breed (Anteau et al. 2014). However, other benthic invertebrate-feeding birds at the site (such as great blue heron) do not migrate and thus could be in the Project Area at any time of the year. Finally, the Project Area represents a very small footprint of ecological habitat within the home ranges of lesser scaup and great blue heron, which also use other portions of Redwood Creek and nearby high-quality habitats at Bair and Greco Islands and Stienberger Slough (Figure 2-3).

4.2.2 Prey tissue modeling

BAFs were applied in order to determine prey (benthic invertebrate) tissue concentrations for the dietary assessment of wildlife. A BAF represents the ratio of tissue concentrations to sediment concentrations based on the following equation:

$$BAF = \frac{C_{tiss}}{C_{sed}} \qquad \textbf{Equation 4-3}$$

Where:

BAF	=	biota accumulation factor
C_{tiss}	=	concentration in tissue (mg/kg dw)
C_{sed}	=	concentration in sediment (mg/kg dw)

BAFs were based on either co-located regional-specific data collected from the Hunters Point Shipyard Parcel F site (Table 4-3) and presented in the validation study (Battelle et al. 2005), or on a similar, independently conducted analysis that used the raw co-located data. Invertebrate tissue BAFs at the Hunters Point Shipyard Parcel F site were derived for copper, mercury, and total PCBs. These BAFs were based on the ratio of co-located mean sediment concentrations to mean tissue concentrations of bent-nose clams (*Macoma nasuta*); the ratio was derived from a 28-day bioaccumulation laboratory study of samples from 5 areas (Battelle et al. 2005). For all other metals considered in this ERA, invertebrate tissue BAFs were derived by applying a similar method to the raw co-located sediment and depurated *M. nasuta* tissue data from the Hunters Point Shipyard Parcel F site: BAFs were determined as the mean co-located BAFs across the five low-volume footprint areas of Parcel F (Areas I, III, VIII, IX, and X) and reference sampling areas.

Table 4-3. Summary of invertebrate BAFs

Constituent	Invertebrate BAF[a]	Source
Antimony	0.17	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Arsenic	2.0	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Beryllium	1	no co-located data available from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005); default BAF of 1.0 used

Constituent	Invertebrate BAF[a]	Source
Cadmium	1.1	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Chromium	0.056	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Cobalt	0.13	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Copper	0.22	as reported in Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Lead	0.12	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Mercury	0.53	as reported in Hunters Point validation study (Battelle et al. 2005)
Molybdenum	3.0	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Nickel	0.078	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Silver	0.93[b]	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Vanadium	0.057	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Zinc	0.79	derived using co-located sediment and tissue data from Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)
Total PCBs	2.0	as reported in Hunters Point Shipyard Parcel F validation study (Battelle et al. 2005)

[a] BAFs are the ratios of tissue concentrations to sediment concentrations, wherein both tissue and sediment are reported on a dry weight basis.

[b] For silver, detection frequency in sediment and tissue samples was less than 100%; BAFs in samples with non-detected values were derived based on detection limits.

BAF – biota accumulation factor

PCB – polychlorinated biphenyl

4.3 Effects Assessment

To determine whether there is an adverse effect on wildlife, a TRV is developed as a threshold dose that may have deleterious effects on an individual of a particular species. Because ERAs are conducted at the population level, this use of individual measures of effects is considered an added layer of conservatism. Both lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) avian TRVs are presented in this section, as both are commonly used in ERAs in accordance with EPA guidance (1997). NOAELs signify conservative screening thresholds that represent the maximum dose at which *no effect* is observed. These thresholds are useful in ruling out the potential for risks to ecological populations when predicted doses at a site are less than NOAELs. While risk calculations based on NOAELs are presented, it is more appropriate to consider LOAELs when evaluating the potential for actual risk, as LOAELs are the lowest doses at which an adverse effect is observed.

EPA Region 9 Biological Technical Assistance Group (BTAG) guidance TRVs (EPA 2009), developed using a consensus-based process, were evaluated for this ERA (Table 4-4). Like screening values, the BTAG TRVs are conservative. High and low TRVs correspond to LOAEL and NOAEL TRVs, respectively; the low TRV (NOAEL) represents the level at which adverse effects are not likely to occur, and the high TRV (LOAEL) represents the lowest concentration of potential adverse effects (Battelle et al. 2005). Body weight-adjusted TRVs specific to lesser scaup were derived from BTAG TRVs using Equation 4-4.

$$TRV_W = TRV \times \left({}^{BW_S}/_{BW_R} \right)^{(1\text{-}1.2)} \qquad \textbf{Equation 4-4}$$

Where:

TRV_W	=	weight-adjusted TRV (mg/kg bw/day)
TRV	=	TRV (mg/kg bw/day)
BW_S	=	body weight of toxicity study receptor (kg)
BW_R	=	body weight of selected ecological receptor (kg)

The body weight-adjusted TRVs derived using Equation 4-4 are presented in Table 4-4.

Table 4-4. Summary of EPA Region 9 BTAG bird TRVs

Constituent	NOAEL TRV[a] (mg/kg dw/day)	NOAEL TRV (bw kg)	Scaup Weight-adjusted NOAEL (mg/kg bw/day)[b]	Heron Weight-adjusted NOAEL (mg/kg bw/day)[b]	LOAEL TRV[a] (mg/kg dw/day)	LOAEL TRV (bw kg)	Scaup Weight-adjusted LOAEL (mg/kg bw/day)[b]	Heron Weight-adjusted LOAEL (mg/kg bw/day)[b]
Antimony	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Arsenic	5.5	1.17	**5.1**	**6.3**	22	1.17	**20**	**25**
Beryllium	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Cadmium	0.7[a]	0.51	**0.77**	**0.5**	10.4	0.084	**16.4**	**20.2**
Chromium	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Cobalt	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Copper	2.3	0.639	**2.4**	**3.0**	52.3	0.409	**60.0**	**73.9**
Lead	1.63[d]	1.81	**1.39**	**1.71**	8.75	0.80	**8.78**	**10.81**
Mercury	0.039	1.0	**0.037**	**0.046**	0.18	1	**0.17**	**0.21**
Molybdenum	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	na[c]	**na[c]**
Nickel	1.38	0.614	**1.46**	**1.80**	56.3	0.58	**60.3**	**74.2**
Silver	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Vanadium	na[c]	na[c]	**na[c]**	**na[c]**	na[c]	na[c]	**na[c]**	**na[c]**
Zinc	17.2	0.955	**16.7**	**20.5**	172	0.955	**167**	**205**
Total PCBs	0.09	0.80	**0.0903**	**0.1112**	1.27	1.72	**1.09**	**1.35**

Shaded cells represent TRVs used in risk calculations.

a NOAEL and LOAEL TRVs were based on low and high TRVs, respectively, reported by EPA Region 9 BTAG (EPA 2009).

b TRVs were adjusted for lesser scaup based on a body weight of 0.815 kg and blue heron based on a body weight of 2.3 kg (see Table 4-1).

c No TRVs were available from EPA Region 9 BTAG (EPA 2009).

d NOAEL TRV was based on EPA Eco-SSL (EPA 2003). See text following this table for additional details.

bw – body weight
BTAG – Biological Technical Assistance Group
dw – dry weight
Eco-SSL – ecological soil screening level
EPA – US Environmental Protection Agency
LOAEL – lowest-observed-adverse-effect level
na – not available
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
TRV – toxicity reference value

As discussed by Battelle et al. (2005), the BTAG NOAEL TRV for lead (0.014 mg/kg bw/day) was associated with high uncertainty; this TRV resulted in risk even under ambient (background) exposure, and it was much lower than widely accepted TRVs, such as those from Oak Ridge National Laboratory (Sample et al. 1996) or EPA ecological soil screening levels (Eco-SSLs) (EPA 2003). Consequently, the NOAEL based on the EPA Eco-SSL (1.63 mg/kg bw/day) (EPA 2005) was used instead of the BTAG NOAEL to evaluate the potential for risk from lead.

No BTAG TRVs were available for seven metals: antimony, beryllium, chromium, cobalt, molybdenum, silver, and vanadium. NOAEL and LOAEL TRVs were developed based on a review of toxicological literature. No literature-based TRVs were available for antimony and beryllium. However, TRVs for chromium, cobalt, and vanadium were based on a comprehensive literature search and review of primary toxicological studies, as well as a systematic process to identify appropriate NOAEL and LOAEL TRVs for the protection of ecological receptors. The list of studies reviewed is presented in Attachment B. Dietary TRVs were derived from those studies that best met the criteria for evaluating the potential for population-level risks to birds. These criteria included the following:

- TRVs were based on endpoints that directly measured survival, growth, or reproduction. Adverse effects on populations may be inferred or extrapolated from measures related to impairments of these endpoints (EPA 1997).
- TRVs were representative of NOAEL and/or LOAEL concentrations or doses. Both NOAELs and LOAELs commonly provide the basis for the TRVs used in ERAs, in accordance with EPA guidance (EPA 1997, 1998).
- TRVs were derived from controlled toxicity studies that used standardized and/or peer-reviewed experiment methods, and in which a clear concentration- or dose-response relationship was reported.
- TRVs were based on the exposure of an organism to a single constituent or specific mixtures of related constituents (i.e., mixtures of constituents within the same class, such as PCBs).
- TRVs reflected a preferred dietary exposure route (EPA 1997).
- TRVs were not based on bioaccumulation studies. Bioaccumulation studies that report only corresponding uptake and bioaccumulation and do not measure effects on specific endpoints are not useful for the derivation of TRVs.
- Unless no other data were available, TRVs were not based on egg productivity or other reproductive endpoints in a domesticated species, such as chickens or Japanese quail; these species have unnaturally high egg-laying rates and toxicological and reproductive sensitivities that are very different from those of wild bird species. Comparing toxic threshold effects on reproductive endpoints

for these species with reproductive endpoints for non-domesticated species is problematic because of differences in reproductive physiology.

The most conservative thresholds available from the published toxicological studies (i.e., the lowest LOAEL and highest bounded NOAEL[3]) that met the criteria presented above were selected as the TRVs for chromium, cobalt, and vanadium, as presented in Table 4-5. A summary of the literature-based TRVs is provided in Table 4-5. Body weight-adjusted TRVs are presented in Table 4-6.

[3] The highest NOAEL below the selected LOAEL based on the same study or same endpoint as the selected LOAEL was selected as the NOAEL.

Table 4-5. Summary of bird TRVs based on comprehensive literature review

Constituent	NOAEL TRV (mg/kg bw/day)	NOAEL Species	NOAEL BW (kg)	NOAEL Effect	NOAEL Source	LOAEL TRV (mg/kg bw/day)	LOAEL Species	LOAEL BW (kg)	LOAEL Effect	LOAEL Source
Chromium	10.5[a]	chicken (chicks)	0.254	body weight, adult mortality	Chung et al. (1985)	105	chicken (chicks)	0.254	body weight, adult mortality	Chung et al. (1985)
Cobalt	2.31[a]	chicken (chicks)	0.1462	body weight	Diaz et al. (1994)	23.1	chicken (chicks)	0.1462	body weight	Diaz et al. (1994)
Vanadium	1.2	chicken (hens)	1.71	body weight	Ousterhout and Berg (1981)	2.3	chicken (hens)	1.71	body weight	Ousterhout and Berg (1981)

[a] NOAEL is the LOAEL divided by 10.

BW or bw – body weight
LOAEL – lowest-observed-adverse-effect level
NOAEL – no-observed-adverse-effect level
TRV – toxicity reference value

Table 4-6. Summary of body weight-adjusted bird TRVs based on comprehensive literature review

Constituent	NOAEL TRV[a] (mg/kg dw/day)	NOAEL TRV bw (kg)	Scaup Weight-adjusted NOAEL (mg/kg bw/day)[b]	Heron Weight-adjusted NOAEL (mg/kg bw/day)[b]	LOAEL TRV[a] (mg/kg dw/day)	LOAEL TRV bw (kg)	Scaup Weight-adjusted LOAEL (mg/kg bw/day)[b]	Heron Weight-adjusted LOAEL (mg/kg bw/day)[b]
Chromium	10.5	0.254	**13.3**	**16.3**	105	0.254	**133**	**163**
Cobalt	2.31	0.1462	**3.26**	**4.01**	23.1	0.1462	**32.6**	**40.1**
Vanadium	1.2	1.71	**1.0**	**1.3**	2.3	1.71	**2.0**	**2.4**

Bold indicates TRVs used in risk evaluation.

[a] NOAEL and LOAEL were TRVs based on Table 4-5.

[b] TRVs were adjusted for lesser scaup and great blue heron based on a body weight of 0.815 and 2.3 kg, respectively (see Table 4-1).

bw – body weight
dw – dry weight
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
TRV – toxicity reference value

This page intentionally left blank.

5 Wildlife Risk Characterization

Dietary doses for lesser scaup and great blue heron were estimated using Equation 5-1 and exposure assumptions presented in Section 4.3. For risk characterization, dietary doses were then compared to the TRVs presented in Section 4.4 to derive a hazard quotient (HQ) using the following equation:

$$HQ = \frac{\text{Dose}}{\text{TRV}} \qquad \textbf{Equation 5-1}$$

Where:

HQ = hazard quotient (unitless)
Dose = calculated exposure dose (mg/kg bw/day)
TRV = toxicity reference value (mg/kg bw/day)

5.1 Baseline Risk

Tables 5-1 and 5-2 provide the baseline risk for lesser scaup and great blue heron, respectively. While risk calculations based on NOAELs are presented, it is more appropriate to consider LOAELs when evaluating the potential for actual risk, as LOAELs are the lowest doses at which an adverse effect is observed. LOAEL HQs are all less than one for baseline risk for lesser scaup and great blue heron.

Table 5-1. Baseline dietary HQs for lesser scaup

Constituents	C_{sed} (mg/kg dw)	Invert BAF	C_{tissue} (mg/kg dw)	Dose (mg/kg bw/day)[a]	TRV (mg/kg bw/day)		SUF = 0.5	
					NOAEL	LOAEL	NOAEL HQ	LOAEL HQ
Antimony	2.52	0.17	0.428	0.0211	na	na	na	na
Arsenic	28.5	2.0	56.9	2.25	5.1	20	0.44	0.11
Beryllium	0.71	1.0	0.71	0.0287	na	na	na	na
Cadmium	2.95	1.1	3.25	0.131	0.77	16.4	0.17	0.0080
Chromium	175	0.056	9.78	0.695	13.3	133	0.052	0.005
Cobalt	24.8	0.13	3.22	0.169	3.26	32.6	0.052	0.005
Copper	1,069	0.22	235	11.0	2.4	60.0	**4.6**	0.18
Lead	413	0.12	49.6	2.67	1.39	8.78	**1.9**	0.30
Mercury	1.74	0.53	0.922	0.0388	0.037	0.17	1.0	0.22
Molybdenum	10.4	3.0	31.2	1.22	na	na	na	na
Nickel	277	0.078	21.6	1.34	1.46	60.3	0.92	0.022
Silver	1.5	0.93	1.39	0.0565	na	na	na	na
Vanadium	75.6	0.057	4.31	0.304	1.0	2.0	0.29	0.15
Zinc	1,697	0.79	1,341	54.9	16.7	167	**3.3**	0.33
Total PCBs	1.03	2.0	2.06	0.081	0.0903	1.09	0.90	0.074

Note: All LOAEL HQs are < 1.0. **Bold** indicates NOAEL HQs > 1.

BAF – biota accumulation factor
bw – body weight
dw – dry weight
HQ – hazard quotient
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
PCB – polychlorinated biphenyl
SUF – site use factor
TRV – toxicity reference value

Table 5-2. Baseline dietary HQs for great blue heron

Constituents	C_{sed} (mg/kg dw)	Invert BAF	C_{tissue} (mg/kg dw)	Dose (mg/kg bw/day)[a]	TRV (mg/kg bw/day)		SUF = 0.5	
					NOAEL	LOAEL	NOAEL HQ	LOAEL HQ
Antimony	6.78	0.17	0.500	0.0232	na	na	na	na
Arsenic	75.5	2.0	67.9	2.75	6.3	25	0.44	0.11
Beryllium	0.566	1.0	0.566	0.0104	na	na	na	na
Cadmium	6.77	1.1	3.70	0.136	0.95	20.2	0.14	0.01
Chromium	214	0.056	164	0.292	16.3	163	0.018	0.0018
Cobalt	39.6	0.13	3.78	0.107	4.01	40.1	0.027	0.0027
Copper	1745	0.22	205	7.54	3.0	73.9	**2.5**	0.10
Lead	826	0.12	46.8	2.08	1.71	10.81	**1.2**	0.19
Mercury	1.80	0.53	0.454	0.018	0.046	0.21	0.39	0.084
Molybdenum	19.1	3.0	33.4	1.04	na	na	na	na
Nickel	366	0.078	23.7	0.646	1.80	74.2	0.36	0.0087
Silver	2.49	0.93	1.37	0.0426	na	na	na	na
Vanadium	72.7	0.057	3.65	0.101	1.3	880	0.079	0.041
Zinc	7,579	0.79	2,518	111	20.5	205	**5.4**	0.54
Total PCBs	3.50	2.0	5.13	0.127	0.11	1.35	**1.1**	0.094

Note: All LOAEL HQs are < 1.0. **Bold** indicates NOAEL HQs > 1.

BAF – biota accumulation factor
bw – body weight
dw – dry weight
HQ – hazard quotient
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
PCB – polychlorinated biphenyl
SUF – site use factor
TRV – toxicity reference value

5.2 Residual Risk

Notwithstanding the fact that LOAEL HQs are all less than one for baseline risk for lesser scaup and great blue heron, this residual risk assessment has been prepared to address the samples with the highest constituent concentrations in both the riprap unit (upper and lower riprap) and the lower riprap/subtidal unit, based on the discussion with EPA during a meeting on July 18, 2018. The following provides a summary of the remedial alternatives that were assumed for purposes of this residual risk assessment:

- **Subtidal dredge –** Dredge to approximately 2.0 ft at select locations (W3-06, W3-07,W3-08, W3-41, W3-43, and W3-48) (Figure 3-1). Surface sediment collected from 0 to -15 cm (0.0 to -0.5 ft) was used to evaluate the potential exposure of ecological receptors at those locations without a proposed remedial action. For those sample locations with a proposed remedial action (i.e., that were proposed for dredging), data from the sediment interval below 2.0 ft was used (i.e., the -2.5- to -3.0-ft interval) for all samples, with the exception of location W3-07, for which the -3.5 to 4.0-ft interval was used. For location W3-43, there were no data for below the 2.0-ft interval. Sediment concentrations from the -2.5- to -3.0-ft interval at neighboring location W3-44 were used to represent concentrations at location W3-43 (W3-44 samples generally had higher concentrations than did samples from other neighboring locations for the -2.5- to -3.0-ft interval).
- **Riprap sand cap –** Install sand cap at select locations (W3-12 in the lower riprap, and W3-14, W3-15, W3-22, W3-23, W3-24, W3-25, and W3-27 in the upper riprap) (Figure 3-1). Surface sediment collected from 0 to -15 cm (0.0 to -0.5 ft) was used to evaluate the potential exposure of ecological receptors at those locations without a proposed remedial action. For those sample locations with a proposed remedial action (i.e., that were proposed for capping with clean sand), reporting limits were used to represent chemical concentrations in the clean sand.

All other exposure assumptions were consistent with those used for the baseline assessment. Tables 5-3 and 5-4 provide the residual risk for lesser scaup and great blue heron, respectively. While risk calculations based on NOAELs are presented, it is more appropriate to consider LOAELs when evaluating the potential for actual risk, as LOAELs are the lowest doses at which an adverse effect is observed. Residual LOAEL HQs are all less than one for lesser scaup and great blue heron.

Table 5-3. Dietary HQs for lesser scaup based on proposed dredging at select locations in subtidal exposure area and placement of sand cap at select locations in lower riprap

Constituents	C_{sed} (mg/kg dw)	Invert BAF	C_{tissue} (mg/kg dw)	Dose (mg/kg bw/day)[a]	TRV (mg/kg bw/day)		SUF = 0.5	
					NOAEL	LOAEL	NOAEL HQ	LOAEL HQ
Antimony	2.13	0.17	0.362	0.0179	na	na	na	na
Arsenic	17.5	2.0	34.9	1.381	5.1	20	0.27	0.067
Beryllium	0.673	1.0	0.673	0.0272	na	na	na	na
Cadmium	4.85	1.1	5.33	0.215	0.77	16.4	0.28	0.013
Chromium	226	0.056	12.7	0.899	13.3	133	0.068	0.0068
Cobalt	28.7	0.13	3.74	0.196	3.26	32.6	0.060	0.0060
Copper	610	0.22	134	6.284	2.4	60.0	**2.6**	0.10
Lead	214	0.12	25.6	1.378	1.39	8.78	0.99	0.16
Mercury	0.875	0.53	0.464	0.0195	0.037	0.17	0.52	0.11
Molybdenum	5.04	3.0	15.1	0.593	na	na	na	na
Nickel	303	0.078	23.7	1.46	1.46	60.3	1.0	0.024
Silver	1.53	0.93	1.42	0.0578	na	na	na	na
Vanadium	73.2	0.057	4.17	0.294	1.0	2.0	0.28	0.15
Zinc	1,408	0.79	1,112	45.5	16.7	167	**2.7**	0.27
Total PCBs	0.897	2.0	1.79	0.0709	0.0903	1.09	0.78	0.065

Note: All LOAEL HQs are < 1.0. **Bold** indicates NOAEL HQs > 1. Select locations for proposed dredging in subtidal area include W3-06, W3-07, W3-08, W3-41, W3-43 and W3-48; select location for proposed sand cap in lower riprap area is W3-12.

BAF – biota accumulation factor
bw – body weight
dw – dry weight
HQ – hazard quotient
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
PCB – polychlorinated biphenyl
SUF – site use factor
TRV – toxicity reference value

Table 5-4. Dietary HQs for great blue heron based on proposed placement of sand cap at select locations in riprap

Constituents	C_{sed} (mg/kg dw)	Invert BAF	C_{tissue} (mg/kg dw)	Dose (mg/kg bw/day)[a]	TRV (mg/kg bw/day)		0.5	
					NOAEL	LOAEL	NOAEL HQ	LOAEL HQ
Antimony	2.944	0.17	0.500	0.0101	na	na	na	na
Arsenic	31.9	2.0	63.8	1.16	6.3	25	0.18	0.046
Beryllium	0.618	1.0	0.618	0.0113	na	na	na	na
Cadmium	3.01	1.1	3.31	0.0606	0.95	20.2	0.064	0.003
Chromium	194	0.056	10.9	0.266	16.3	163	0.016	0.0016
Cobalt	22.7	0.13	2.95	0.0613	4.01	40.1	0.015	0.0015
Copper	957	0.22	210	4.13	3.0	73.9	**1.4**	0.056
Lead	403	0.12	48.3	1.02	1.71	10.81	0.59	0.094
Mercury	0.914	0.53	0.484	0.00905	0.046	0.21	0.20	0.043
Molybdenum	9.63	3.0	28.9	0.523	na	na	na	na
Nickel	310	0.078	24.2	0.547	1.80	74.2	0.30	0.0074
Silver	1.49	0.93	1.39	0.0255	na	na	na	na
Vanadium	60.1	0.057	3.42	0.0832	1.3	880	0.065	0.034
Zinc	3446	0.79	2,722	50.2	20.5	205	2.5	0.25
Total PCBs	2.86	2.0	5.72	0.104	0.11	1.35	0.94	0.077

Note: **Bold** indicates NOAEL HQs > 1. All LOAEL HQs are < 1.0. Select locations for sand cap remedial action include W3-12, WS3-14, W3-15, W3-22, W3-23, W3-24, W3-25, and W3-27.

BAF – biota accumulation factor
bw – body weight
dw – dry weight
HQ – hazard quotient
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
PCB – polychlorinated biphenyl
SUF – site use factor
TRV – toxicity reference value

5.3 BENTHIC BASELINE AND RESIDUAL ASSESSMENT

The probability of baseline and residual risk to the benthic community was assessed using the site-specific surface sediment data available for the lower riprap/subtidal unit, as well as regional toxicity and benthic community data for similar mesohaline habitats in San Francisco Bay, including other areas of Redwood Creek. A summary of this assessment is presented in this section, and additional details are provided in Attachment A.

Baseline and residual metal and PCB concentrations in lower riprap/subtidal unit surface sediment (Terraphase 2018) exceed effects range - median (ERM) values; however, ERM values should not be used to predict effects in risk assessments (Long and Morgan 1990; Long et al. 1995; MacDonald et al. 1996). Regional data support the lack of a relationship between ERM exceedances and adverse effects on the benthic invertebrate community. In fact, the regional sediment toxicity data and regional benthic community data suggest that there is minimal risk to benthic populations within the lower riprap/subtidal unit:

- Although ERM exceedances were observed, no toxicity to amphipods (*Eohaustorius estuaries*) and only limited toxicity to urchin larvae (*Stronglyocentrotus purpuratus)* was observed at the Hunters Point Shipyard site, based on laboratory toxicity tests using site sediment (Battelle et al. 2005). Furthermore, toxicity results for both species indicated no dose-response relationship for sediment chemistry and no relationship between actual toxicity response and predicted toxicity response based on exceedances of ERM values, either as individual ERMs or ERM quotient (ERMq) values.
- No relationship was found between benthic species richness or *A. abdita* abundance and ERMq values based on data collected within the south bay mesohaline area of San Francisco Bay, including one sediment site located in Redwood Creek (SCCWRP 2010).
- The City of Redwood City reported that PCB concentrations within Redwood Creek sediment just upstream of the Project Area were found to be greater than ambient values and ERMs; however, the concentrations were found not to be detrimental to benthic organisms based on the bioavailability of contaminants (EKI 2016).

5.4 UNCERTAINTY IN BASELINE AND RESIDUAL ASSESSMENT

It is important to identify the uncertainties associated with the exposure and effects assumptions used to characterize risks (EPA 1997, 1998; California DTSC 1996). The following key uncertainties were identified for these baseline and residual ERAs:

- The selected SUF is associated with uncertainty. An SUF of 0.5 represents a very conservative estimate of expected habitat use in the Project Area by lesser scaup and great blue heron, considering the Project Area size and neighboring habitat.
- There is uncertainty associated with the use of BAFs to model prey tissue in the absence of empirical data. Regional data (from Hunters Point Shipyard) were used to establish BAFs, but it is unknown whether these BAFs over- or under-predict concentrations in potential benthic invertebrate tissue that may be prey for birds in the lower riprap/subtidal unit. Tissue concentrations vary based on site-specific parameters, including bioavailability and lipid content of organisms present in the sediment. Typically, non-site-specific BAFs overpredict actual prey tissue concentrations due to inherent conservative assumptions in the model.
- There is uncertainty associated with the TRVs selected for the evaluation of risk. It is unknown whether lesser scaup and great blue heron are more or less sensitive to the contaminants being evaluated than the species tested in the selected TRVs studies. BTAG TRVs include NOAELs and LOAELs based on endpoints other than survival, growth, and reproduction, so those NOAELs and LOAELs may overpredict the potential for adverse effects on ecological populations. The literature-based TRVs for chromium, cobalt, and vanadium are based on the most sensitive species tested in the available toxicological literature for survival, growth, and reproduction.
- There is uncertainty associated with the assumption of 100% ingestion of benthic invertebrates, particularly for great blue heron. While the diet of lesser scaup is predominately aquatic benthic invertebrates such as insects, crustaceans, and mollusks, scaup may also consume some portion of vegetation and fish (EPA 1993; Anteau et al. 2014). Fish are the preferred prey of great blue heron (EPA 1993), but they also feed opportunistically on a variety of organisms, including small mammals, reptiles, amphibians, insects, and crustaceans (Kushlan 1978; Butler 1993).
- The exposure parameters assumed for lesser scaup and great blue heron in the dietary model are considered to be associated with relatively low uncertainty, since body weights and ingestion rates specific to the species were available from the general literature.
- This assessment assumes 100% bioavailability, a highly conservative assumption given that actual bioavailability is much less under actual environmental conditions.

6 ERA Conclusions

The baseline ERA predicted that maximally exposed representative wildlife populations have probable risk estimates (LOAEL HQs < 1; Table 5-1) well below levels that would result in unacceptable risk. The potential risk to aquatic birds that may use the Project Area is considered negligible based on the risk characterization results. Exposure is limited, and even given conservative assumptions in the risk assessment (i.e., low-effect thresholds, high SUFs, likelihood of feeding preference, and bioavailability of constituents), there is little likelihood of unacceptable risk in the Project Area.

The residual risk estimates assume the remediation of samples with the highest constituent concentrations based on the discussion with EPA. Residual risk estimates also show that wildlife populations have probable risk estimates (LOAEL HQs < 1; Table 5-1) well below levels that would result in unacceptable risk and that on average are 9% and 40% lower than baseline conditions for lesser scaup and great blue heron, respectively.

The benthic community in the upper few centimeters of sediment in the Project Area is typical of what would be expected in an industrial shipping channel. Based on Project Area baseline and residual chemistry data, risk analyses of nearby benthic toxicity and community, and the lack of causative toxicity of constituents at concentrations found at the site, there exists low probability of unacceptable risk to the benthic community from COCs at the site for baseline and residual conditions.

Table 6-1. Summary of baseline and residual dietary HQs for lesser scaup and great blue heron

Chemical	Scaup (SUF = 0.5)				Heron (SUF = 0.5)			
	Baseline		Residual		Baseline		Residual	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Antimony	na	na	na	na	na	na	na	na
Arsenic	0.44	0.11	0.27	0.067	0.44	0.11	0.18	0.046
Beryllium	na	na	na	na	na	na	na	na
Cadmium	0.17	0.0080	0.28	0.013	0.14	0.0068	0.064	0.0030
Chromium	0.052	0.0052	0.068	0.0068	0.018	0.0018	0.016	0.0016
Cobalt	0.052	0.0052	0.060	0.0060	0.027	0.0027	0.015	0.0015
Copper	**4.6**	0.18	**2.6**	0.10	**2.5**	0.10	**1.4**	0.056
Lead	**1.9**	0.30	0.99	0.16	**1.2**	0.19	0.59	0.094
Mercury	1.0	0.22	0.52	0.11	0.39	0.084	0.20	0.043
Molybdenum	na	na	na	na	na	na	na	na
Nickel	0.92	0.022	1.0	0.024	0.36	0.0087	0.30	0.0074

Table 6-1. Summary of baseline and residual dietary HQs for lesser scaup and great blue heron

Chemical	Scaup (SUF = 0.5)				Heron (SUF = 0.5)			
	Baseline		Residual		Baseline		Residual	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Silver	na	na	na	na	na	na	na	na
Vanadium	0.29	0.15	0.28	0.15	0.056	0.053	0.065	0.034
Zinc	**3.3**	0.33	**2.7**	0.27	**5.4**	0.54	**2.5**	0.25
Total PCBs	0.90	0.074	0.78	0.065	**1.1**	0.094	0.94	0.077

Note: All LOAEL HQs are < 1.0. NOAEL values > 1.0 are in **bold**.

HQ – hazard quotient
LOAEL – lowest observed adverse effect level
na – not available
NOAEL – no observed adverse effect level
PCB – polychlorinated biphenyl
SUF – site use factor

7 References

Anteau MJ, DeVink J-M, Koons DN, Austin JE, Custer CM, Afton AD. 2014. Lesser scaup (*Aythya affinis*), version 2.0. In: Rodewald PG, ed, The Birds of North America. Cornell Lab of Ornithology, Ithaca, NY, Available from: https://doi.org/10.2173/bna.338.

Battelle, BBL, Neptune. 2005. Final. Hunters Point Shipyard Parcel F validation study report. San Francisco Bay, California. Battelle; Blasland, Bouck & Lee, Inc.; and Neptune & Company.

Beyer WN, Perry MC, Osenton PC. 2008. Sediment ingestion rates in waterfowl (Anatidae) and their use in environmental risk assessment. Integr Environ Assess Manag 4(2):246-251.

Butler RW. 1993. Time of breeding in relation to food availability of female great blue herons (*Ardea herodias*). Auk 110:693-701.

California DTSC. 1996. Guidance for ecological risk assessment at hazardous waste sites and permitted facilities. Part A: Overview. California Environmental Protection Agency, Department of Toxic Substances Control, Human and Ecological Risk Division, Sacramento, CA.

CDFW. 2017. Bair Island ecological reserve [online]. California Department of Fish and Wildlife, Sacramento, CA. Available from: https://www.wildlife.ca.gov/Lands/Places-to-Visit/Bair-Island-ER#10492117-history.

Chung KH, Sukgrand YO, Kang MH. 1985. The toxicity of chromium and its interaction with manganese and molybdenum in chicks. Kor J Anim Sci 27(6):391-395.

De La Cruz SEW, Woo I, Flanagan A, Mittelstaedt H, Donald J. 2017. Assessing the impact of periodic dredging on macroinvertebrate prey availability for benthic foraging fishes. Final study plan and preliminary pilot study results. US Geological Survey.

Diaz GJ, Julian RJ, Squires EJ. 1994. Lesions in broiler chickens following experimental intoxication with cobalt. Avian Dis 38(2):308-316.

EKI. 2016. Redwood Creek characterization report. Volume 1 of 2. Erler & Kalinowski, Inc., Burlingame, CA.

EPA. 1993. Wildlife exposure factors handbook. EPA/600/R-93/187a. Office of Research and Development, US Environmental Protection Agency, Washington, DC.

EPA. 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. EPA/540/R-97/006. Interim final.

Environmental Response Team, US Environmental Protection Agency, Edison, NJ.

EPA. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002 F. Risk Assessment Forum, US Environmental Protection Agency, Washington, DC.

EPA. 2002. Calculating upper confidence limits for exposure point concentrations at hazardous waste sites. Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC.

EPA. 2003. Guidance for developing ecological soil screening levels. OSWER Directive 9285.7-55 [online]. Office of Solid Waste and Emergency Response, US Environmental Protection Agency, Washington, DC. Updated November 2003. Available from: http://rais.ornl.gov/documents/ecossl.pdf.

EPA. 2005. Ecological soil screening levels for lead. Interim final. OSWER Directive 9285.7-70. Office of Solid Waste and Emergency Response, US Environmental Protection Agency, Washington, DC.

EPA. 2009. US EPA Region 9 Biological Technical Assistance Group (BTAG) recommended toxicity reference values for birds [online]. US Environmental Protection Agency Region 9, San Francisco, CA. Updated 2/24/09. [Cited 1/26/10.] Available from: http://www.dtsc.ca.gov/assessingrisk/upload/eco_btag-mammal-bird-trv-table.pdf.

EPA, E&E. 2013. Final engineering evaluation/cost analysis. Yosemite Slough, San Francisco, California. US Environmental Protection Agency and Ecology and Environment, Inc.

EPA. 2015. Determination of the biologically relevant sampling depth for terrestrial and aquatic ecological risk assessments. EPA/600/R-15/176. US Environmental Protection Agency, Ecological Risk Assessment Support Center, Cincinnati, OH.

EPA. 2016. Statistical software 5.1.00 for environmental applications for data sets with and without nondetect observations [online]. Office of Research and Development, US Environmental Protection Agency, Washington, DC. Updated June 20, 2016. Available from: https://www.epa.gov/land-research/proucl-software.

ESA. 2017. Port of Redwood City Wharves 3 and 4 fender replacement project. Bay Conservation and Development Commission (BCDC) permit application. ESA, Sacramento, CA.

Kushlan JA. 1978. Feeding ecology of wading birds. In: Sprunt A, Oge J, Winckler S, eds, Wading birds, research report No. 7. National Audubon Society, New York, NY, pp 249-297.

Lacroix DL, Boyd S, Esler D, Kirk M, Lewis T, Lipovsky S. 2005. Surf scoters *Melanitta perspicillata* aggregate in association with ephemerally abundant polychaetes. Mar Ornith 33:61-63.

Long ER, Morgan LG. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration, Seattle, WA.

Long ER, MacDonald DD, Smith SL, Calder FD. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environ Manage 19:81-97.

MacDonald DD, Carr RS, Calder FD, Long ER, Ingersoll CG. 1996. Development and evaluation of sediment quality guidelines for Florida coastal waters. Ecotoxicology 5:253-278.

Nagy KA. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews Series B: Livestock Feeds and Feeding 71(10):21R-31R.

Nichols FH, Pamatmat MM. 1988. The ecology of the soft-bottom benthos of San Francisco Bay: a community profile. Biological report 85(7.19). US Fish and Wildlife Service, Slidell, LA.

Nichols FH, Thompson JK. 1985. Time scales of change in the San Francisco Bay benthos. Hydrobiologia 129:121-138.

Ousterhout LE, Berg LR. 1981. Effects of diet composition on vanadium toxicity in laying hens. Poult Sci 60:1152-1159.

Poulton VK, Lovvorn JR, Takekawa JW. 2002. Clam density and scaup feeding behavior in San Pablo Bay, California. Condor 104:518-527.

Richmond OMW, Dulava S, Strong CM, Albertson JD. 2014. San Francisco estuary midwinter waterfowl surfey: 2012 survey results and trend analysis (1981-2012). US Fish and Wildlife Service, Fremont, CA.

Sample BE, Opresko DM, Suter GW. 1996. Toxicological benchmarks for wildlife. 1996 revision. ES/ERM-86/R3. Office of Environmental Management, US Department of Energy, Washington, DC.

SCCWRP. 2010. California sediment quality objectives database [online]. Southern California Coastal Water Research Project. Updated January 15, 2010. Available from: http://sccwrp.org/Data/SearchAndMapData/DataCatalog/CaliforniaSedimentQualityObjectivesDatabase.aspx.

Terraphase. 2018. Final. Sediment investigation report, Sims Metal Management, Redwood City, California. Terraphase Engineering Inc., Oakland, CA.

Thompson B, Ranasinghe JA, Melwani A, Weisberg SB. 2013. Benthic macrofaunal assemblages of the San Francisco Estuary and Delta, USA. Environ Monit Assess 185(3):2281-2295.

US District Court. 2014. Consent decree. Civil Action No. C14-4209. US District Court for the Northern District of California.

USFWS. 2006. Final environmental impact statement/environmental impact report. Bair Island restoration and management plan, Don Edwards San Francisco Bay National Wildlife Refuge, Bair Island Ecological Reserve. US Fish & Wildlife Service.

USFWS. 2012. Don Edwards San Francisco Bay final comprehensive conservation plan. US Fish and Wildlife Service.

Attachment A. Baseline and Residual Benthic Community Potential Risk Evaluation

Table of Contents

Tables

Figures

Acronyms

BAZ	biologically active zone
COC	constituent of concern
DDT	dichlorodiphenyltrichloroethane
dw	dry weight
ERA	ecological risk assessment
ERM	effects range – median
ERMq	effects range – median quotient
HPAH	high-molecular-weight polycyclic aromatic hydrocarbons
LOEC	lowest-observed-effect concentration
LPAH	low-molecular-weight polycyclic aromatic hydrocarbons
NOEC	no-observed-effect concentration
PCB	polychlorinated biphenyl
SCCWRP	Southern California Coastal Water Research Program
SETAC	Society of Environmental Toxicology and Chemistry
TBT	tributyltin

1 Introduction

The area evaluated by this ecological risk assessment (ERA) (hereafter referred to as the Project Area) is part of an industrial shipping channel and active industrial use area. Therefore, the benthic community in the Project Area is subject to the associated pressures, making it questionable whether a management goal for benthic community protection is appropriate for this site. Regardless, for completeness, a benthic community evaluation was conducted as part of the ERA. As for the wildlife assessment, the ERA completed for sites in the vicinity of the Project Area was reviewed as part of a line-of-evidence evaluation to determine if the benthic community is being adversely affected by the metals and polychlorinated biphenyls (PCBs), collectively refered to as constituents of concern (COCs), detected in Project Area sediment within a relevant exposure area.

The probability of risk to the benthic community has been indirectly assessed using the data available for COC concentrations in the upper 0 to -15 cm of sediment. This depth reasonably represents the biologically active zone (BAZ) for the majority of the benthic species in the mesohaline environment of San Francisco Bay, as discussed in Section 3.1 of the main document.

As described in the main document, for the purposes of the ERA, the Project Area was divided into two exposure evaluation units: the lower riprap/subtidal unit and the riprap unit (lower and upper riprap). In the upper riprap, consituents identified in pockets of sediment in between the rock covering were not evaluated quantitatively for the direct exposure of benthic organisms, since this sediment represents a limited pathway (see Figure 3-2 of the main text). Benthic invertebrates were evaluated as prey in the upper riprap of the riprap unit (see Section 3.4.2 of the main text). Surface sediment concentrations within the BAZ (0 to -15 cm) in the lower riprap/subtidal unit were evaluated qualitatively by comparing them to effects range – median (ERM) screening values (Section 2 of this appendix). Benthic community and toxicitiy data from nearby mesohaline environment sites, including the Hunters Point Shipyard Parcel F site, were also used to evaluate the probability that the benthic community in the Project Area is at risk due to exposure to sediment chemicals post-remediation (Section 3 of this appendix).

2 Baseline and Residual Sediment Chemistry

Baseline and residual sediment constituent concentrations (Terraphase 2018) from a depth of 0 to -15 cm in the lower riprap/subtidal unit exceed ERM values (Tables A2-1 and A2-2). The percentage of baseline lower riprap/subtidal sediment samples to exceed ERM values ranges from 0% (cadmium) to 100% (nickel). The number of samples to exceed ERM values for residual lower rip/subtidal sediment is less than baseline for all COCs (average of 16% difference) except for mercury and cadmium

(Tables A2-1 and A2-2). However, comparison to ERM values should not be used to predict effects in risk assessments (Long and Morgan 1990; Long et al. 1995; MacDonald et al. 1996). Regional data support the lack of a relationship between ERM exceedances and adverse effects on the benthic invertebrate community. As described in Section 3, the regional sediment toxicity data and regional benthic community data suggest that there is minimal risk to be expected for benthic populations within the Project Area.

Table A2-1. Comparison of baseline lower riprap/subtidal unit Project Area surface sediment concentrations to ERM values

Area	Location	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Silver mg/kg	Zinc mg/kg	Total PCBs µg/kg
ERM		70	9.6	370	270	218	0.71	51.6	3.7	410	180
Count of samples > ERM (% samples)		1 (2%)	0 (0%)	3 (6%)	16 (33%)	8 (17%)	12 (25%)	48 (100%)	2 (4%)	23 (48%)	34 (71%)
Lower riprap	W3-10	32	4.02	120	**365**	171	**1.7**	**705**	1.38	**1,770**	**304**
	W3-11	**79.5**	5.94	**461**	**2,320**	**379**	**1.27**	**222**	**6**	**4,740**	**1,670**
	W3-12	56.2	2.52	261	**2,230**	**1,120**	0.448	**218**	1.84	**3,120**	**1,670**
	W3-13	19.1	7.49	228	**1,640**	**469**	0.641	**688**	1.28	**4,910**	**1,940**
	W3-19	12.8	1.56	101	238	106	0.526	**108**	0.403 J	**541**	**1,290**
	W3-20	20.5	3.51	122	185	152	**0.798**	**130**	0.402 J	**955**	**1,050**
	W3-21	11.7	1.55	107	132	76.9	**1.45**	**124**	0.522 J	**572**	**540**
	W3-26	23.4	0.555 J	104	212	77.2	0.323	**122**	1.24	**913**	153
	W3-27	68.7	3.33	**488**	**3,970**	**614**	0.562	**371**	2.54	**3,610**	**2,010**
	W3-28	46.7	5.38	161	**623**	**447**	0.672	**180**	1.5	**2,670**	**1,070**
	W3-29	16.8	1.33	114	**579**	147	0.507	**98.7**	0.729	**919**	**1,500**
	W3-30	12.8	0.644 J	95.7	77.7	51.1	0.338	**101**	0.431 J	342	**242**
	W3-58	9.23	1.65	92.1	68.2	46.2	0.486	**102**	0.593 J	232	**240**

Table A2-1. Comparison of baseline lower riprap/subtidal unit Project Area surface sediment concentrations to ERM values

Area	Location	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Silver mg/kg	Zinc mg/kg	Total PCBs µg/kg
Subtidal	W3-01	12.1	1.45 U	89.7	66.6	41.7	0.34	**103**	0.796	208	123
	W3-02	17.5	1.46 U	101	106	60.8	**0.752**	**114**	1.28	425	**329**
	W3-03	12.7	1.46 U	89.7	65.5	41.5	0.389	**98.7**	0.752	202	119
	W3-04	17.9	1.74 U	93.5	76	47.5	0.482	**104**	1.01	247	135
	W3-05	20.8	0.516 J	116	**458**	216	0.4	**138**	1.45	**768**	**381**
	W3-06	13.6	1.65 U	98.5	93.3	49.4	0.347	**109**	0.782 J	273	154
	W3-07	47.6	5	**780**	**2,280**	**312**	**1.02**	**931**	1.16	**3,340**	**2,510**
	W3-08	31.4	2.93	128	**360**	217	**1.37**	**352**	0.894	**1,940**	**2,010**
	W3-09	19.9	2.29	126	**416**	**277**	**1.4**	**161**	0.402 J	**1,060**	**369**
	W3-32	10.4	0.804 J	106	73.8	96.9	0.375	**103**	0.288 J	459	116
	W3-33	9.58	0.504 J	97.9	68.2	36.8	0.353	**99.3**	0.262 J	191	102
	W3-34	6.78	0.593 J	82.4	**534**	41.2	0.181 U	**88.5**	0.23 J	228	**372**
	W3-35	9.02	0.58 J	92.2	56.7	34.7	0.374	**93.3**	0.417 J	163	72
	W3-36	9.7	0.974 J	109	80.7	53.4	0.531	**142**	0.363 J	266	**184**
	W3-37	9.57	0.692 J	99.7	76.2	44.4	0.529	**112**	0.356 J	245	**194**
	W3-38	6.89	0.872 J	110	68.5	52.2	**0.855**	**118**	0.262 J	243	**265**
	W3-39	7.68	0.502 J	103	67.8	40.4	0.0613 J	**107**	0.455 J	200	107
	W3-40	7.93	0.823 J	106	77.8	154	0.616	**110**	0.258 J	250	**392**
	W3-41	15.8	5.49	149	**458**	**2,240**	0.434	**160**	**3.8**	**1,700 B**	**990**
	W3-42	8.35	1.07 J	104	113	54.2	0.309	**106**	0.666 U	334 B	**281**
	W3-43	20.2	2.59	159	**511**	114	0.443 B	**118**	0.309 J	**780**	**710**
	W3-44	17.3	0.741 J	95	117	63.8	0.549 B	**96.3**	0.37 J	390	**460**
	W3-45	15.2	0.531 J	108	89.1	53.6	**0.876 B**	**107**	0.439 J	275	173
	W3-46	7.81	0.739 J	87.7	73.2	40.2	0.688	**96.3**	0.218 J	232	149
	W3-47	21.4	1.46 U	155	**1,710**	63.3	0.456 B	**131**	0.728 U	**572**	**356**
	W3-48	16.5	5.12	169	**3,120**	186	**10.5**	**182**	0.779	**2,180**	**2,050**
	W3-49	12.1	2.38	115	217	103	0.484	**120**	1.16	**658 B**	**560**
	W3-50	11.7	1.22	115	237	103	0.371	**121**	0.476 J	**591**	**800**
	W3-51	7.18	0.701 J	79.6	58.6	33.9	0.379	**91.6**	0.714 U	173	107
	W3-52	8.93	0.734 J	90.5	68	44.5	0.252	**97.2**	0.269 J	227	174
	W3-53	8.54	0.796 J	93.4	61.4	37	0.371	**94.8**	0.507 J	180	**190**
	W3-54	7.35	0.676 J	78.9	54.5	32.6	0.16 J	**79.8**	0.798 U	166	**190**
	W3-55	7.79	1.55 J	87.6	55.2	54.4	0.334	**87.3**	0.437 J	172	61
	W3-56	9.66	1.76	92.7	68.6	62.8	0.421	**94.1**	0.553 J	216	**210**
	W3-57	8.34	1.47 J	103	61.6	43.5	**1.74**	**107**	0.3 J	183	**230**

Bold values are greater than the respective ERM concentrations.

B – analyte present in an associated method blank
J – estimated concentratration
U – not detected at given concentration
ERM – effects range – median
PCB – polychlorinated biphenyl

Table A2-2. Comparison of residual lower riprap/subtidal unit Project Area surface sediment concentrations to ERM values

Area	Location	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Silver mg/kg	Zinc mg/kg	Total PCBs µg/kg
ERM		70	9.6	370	270	218	0.71	51.6	3.7	410	180
Count of samples > ERM (% samples)		1 (2%)	1 (2%)	1 (2%)	13 (27%)	6 (13%)	15 (31%)	46 (96%)	2 (4%)	21 (44%)	33 (69%)
Lower riprap	W3-10	32	4.02	120	**365**	171	**1.7**	**705**	1.38	**1,770**	**304**
	W3-11	**79.5**	5.94	**461**	**2,320**	**379**	**1.27**	**222**	**6**	**4,740**	**1,670**
	W3-12[a]	2.3 U	1.54 U	0.766 U	1.53 U	1.53 U	0.181 U	0.766 U	0.545 U	3.07 U	21 U
	W3-13	19.1	7.49	228	**1,640**	**469**	0.641	**688**	1.28	**4,910**	**1,940**
	W3-19	12.8	1.56	101	238	106	0.526	**108**	0.403 J	**541**	**1,290**
	W3-20	20.5	3.51	122	185	152	**0.798**	**130**	0.402 J	**955**	**1,050**
	W3-21	11.7	1.55	107	132	76.9	**1.45**	**124**	0.522 J	**572**	**540**
	W3-26	23.4	0.555 J	104	212	77.2	0.323	**122**	1.24	**913**	153
	W3-27[a]	2.3 U	1.54 U	0.766 U	1.53 U	1.53 U	0.181 U	0.766 U	0.545 U	3.07 U	21 U
	W3-28	46.7	5.38	161	**623**	**447**	0.672	**180**	1.5	**2,670**	**1,070**
	W3-29	16.8	1.33	114	**579**	147	0.507	**98.7**	0.729	**919**	**1,500**
	W3-30	12.8	0.644 J	95.7	77.7	51.1	0.338	**101**	0.431 J	342	**242**
	W3-58	9.23	1.65	92.1	68.2	46.2	0.486	**102**	0.593 J	232	**240**

Table A2-2. Comparison of residual lower riprap/subtidal unit Project Area surface sediment concentrations to ERM values

Area	Location	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Silver mg/kg	Zinc mg/kg	Total PCBs µg/kg
Subtidal	W3-01	12.1	1.45 U	89.7	66.6	41.7	0.34	**103**	0.796	208	123
	W3-02	17.5	1.46 U	101	106	60.8	**0.752**	**114**	1.28	425	**329**
	W3-03	12.7	1.46 U	89.7	65.5	41.5	0.389	**98.7**	0.752	202	119
	W3-04	17.9	1.74 U	93.5	76	47.5	0.482	**104**	1.01	247	135
	W3-05	20.8	0.516 J	116	**458**	216	0.4	**138**	1.45	**768**	**381**
	W3-06[b]	12.5	3.4	123	149	138	**1.41**	**306**	2.38	395	**480**
	W3-07[c]	15.5	4.47	158	206	199	**0.928**	**163**	**4.14**	**629**	**1,300**
	W3-08[b]	23.3	5.63	147	**349**	**424**	**1.69**	**292**	1.59	**1,270**	**490**
	W3-09	19.9	2.29	126	**416**	**277**	**1.4**	**161**	0.402 J	**1,060**	**369**
	W3-32	10.4	0.804 J	106	73.8	96.9	0.375	**103**	0.288 J	459	116
	W3-33	9.58	0.504 J	97.9	68.2	36.8	0.353	**99.3**	0.262 J	191	102
	W3-34	6.78	0.593 J	82.4	**534**	41.2	0.181 U	**88.5**	0.23 J	228	**372**
	W3-35	9.02	0.58 J	92.2	56.7	34.7	0.374	**93.3**	0.417 J	163	72
	W3-36	9.7	0.974 J	109	80.7	53.4	0.531	**142**	0.363 J	266	**184**
	W3-37	9.57	0.692 J	99.7	76.2	44.4	0.529	**112**	0.356 J	245	**194**
	W3-38	6.89	0.872 J	110	68.5	52.2	**0.855**	**118**	0.262 J	243	**265**
	W3-39	7.68	0.502 J	103	67.8	40.4	0.0613 J	**107**	0.455 J	200	107
	W3-40	7.93	0.823 J	106	77.8	154	0.616	**110**	0.258 J	250	**392**
	W3-41[b]	14	6.96	133	**340**	186	**0.894**	**207**	1.33	**1,210**	**1,300**
	W3-42	8.35	1.07 J	104	113	54.2	0.309	**106**	0.666 U	334 B	**281**
	W3-43[d]	18.5	**25.3**	193	**1,460**	685	**2.13**	**315**	2.08	**3,020**	**7,200**
	W3-44	17.3	0.741 J	95	117	63.8	0.549 B	**96.3**	0.37 J	390	**460**
	W3-45	15.2	0.531 J	108	89.1	53.6	**0.876 B**	**107**	0.439 J	275	173
	W3-46	7.81	0.739 J	87.7	73.2	40.2	0.688	**96.3**	0.218 J	232	149
	W3-47	21.4	1.46 U	155	**1,710**	63.3	0.456 B	**131**	0.728 U	**572**	**356**
	W3-48[b]	11.4	6.49	129	**380**	209	**0.792**	**141**	0.475 J	**1,180**	**1,900**
	W3-49	12.1	2.38	115	217	103	0.484	**120**	1.16	**658 B**	**560**
	W3-50	11.7	1.22	115	237	103	0.371	**121**	0.476 J	**591**	**800**
	W3-51	7.18	0.701 J	79.6	58.6	33.9	0.379	**91.6**	0.714 U	173	107
	W3-52	8.93	0.734 J	90.5	68	44.5	0.252	**97.2**	0.269 J	227	174
	W3-53	8.54	0.796 J	93.4	61.4	37	0.371	**94.8**	0.507 J	180	**190**
	W3-54	7.35	0.676 J	78.9	54.5	32.6	0.16 J	**79.8**	0.798 U	166	**190**
	W3-55	7.79	1.55 J	87.6	55.2	54.4	0.334	**87.3**	0.437 J	172	61
	W3-56	9.66	1.76	92.7	68.6	62.8	0.421	**94.1**	0.553 J	216	**210**
	W3-57	8.34	1.47 J	103	61.6	43.5	**1.74**	**107**	0.3 J	183	**230**

Bold values are greater than the respective ERM concentrations.

[a] Sample proposed for remediation using placement of clean sand cap; concentrations are reporting limits.

[b] Sample proposed for remediation using dredging; concentrations are from the 2.5- to 3.0-ft depth interval.

[c] Sample proposed for remediation using dredging; concentrations are from the 3.5- to 4.0-ft depth interval.

[d] Sample proposed for remediation using dredging. No subsurface sediment chemistry data available. Concentrations from nearby sample W3-44 from a depth interval of 3.5 to 4.0 ft used.

B – analyte present in an associated method blank
ERM – effects range – median
PCB – polychlorinated biphenyl

J – estimated concentratration
U – not detected at given concentration

3 Potential Baseline and Residual Risk to the Benthic Community

This section assesses the potential baseline and residual risk Project Area benthic community using multiple lines of evidence:

- An evaluation of benthic community and toxicitiy data from a nearby site's ERA (i.e., Hunters Point Shipyard Parcel F site) (Battelle et al. 2005)
- A comparison of infaunal community data metrics from the south bay of San Francisco Bay ERMs (SCCWRP 2010)
- An assessment of spiked sediment toxicity data (SETAC SEDAG and SCCWRP 2018)

3.1 Hunters Point Shipyard Parcel F Site Benthic Data

As noted in Section 3.1 of the main document, the feeding mode for most of the benthic species that inhabit the mesohaline environment of San Francisco Bay is consuming detritus and near-surface sediments, or filtering suspended particles in the near-bottom water column. Exposure to Project Area sediment is well represented by the two species used in the Hunter's Point Shipyard Parcel F site investigation (Battelle et al. 2005), which included acute sediment toxicity tests using the amphipod *Eohaustorius estuarius* and larval tests using the urchin *Stronglyocentrotus purpuratus*. A larval test is used to evaluate the potential toxicity of dissolved concentrations and suspended particles. Baseline and residual Project Area and Hunters Point Shipyard Parcel F site sediment concentration ranges overlap for several metals and total PCBs in sediment. However, baseline and residual zinc and lead concentrations in the lower riprap/subtidal unit surface sediment are higher than those found at the Hunters Point Shipyard Parcel F site (Table A3-1).

Table A3-1. Comparison of Hunters Point Shipyard Parcel F site and baseline and residual Project Area lower riprap/subtidal surface sediment concentrations

	Surface Sediment Concentration Range (mg/kg dw)			
Chemical	Hunters Point Shipyard Parcel F Site	Project Area – Baseline	Project Area – Residual[a]	ERM (mg/kg)
Arsenic	5.18–18.2	6.78–**79.5**	2.3–**79.5**	70
Cadmium	0.184–0.845	0.502–7.49	0.502–**25.3**	9.6
Chromium	156–**464**	78.9–**780**	0.766–**461**	370
Copper	12–**1,050**	54.5–**3,970**	1.53–**2,320**	270
Lead	11–**275**	32.6–**2,240**	1.53–**685**	218
Mercury	0.0808–7.47	0.0613–**10.5**	0.0613–**2.13**	0.71
Nickel	**59.6–250**	**79.8–931**	0.766–705	51.6
Silver	< 0.066–2.8	0.218–**6.0**	0.218–**6.0**	3.7

Table A3-1. Comparison of Hunters Point Shipyard Parcel F site and baseline and residual Project Area lower riprap/subtidal surface sediment concentrations

Chemical	Surface Sediment Concentration Range (mg/kg dw)			ERM (mg/kg)
	Hunters Point Shipyard Parcel F Site	Project Area – Baseline	Project Area – Residual[a]	
Zinc	47–322	163–**4,910**	3.07–**4,910**	410
Total PCBs	0.011–**5.186**	0.061–**2.510**	0.021–**7.20**	0.180

Sources: Hunters Point Shipyard Parcel F site data are from Battelle et al. (2005) and Redwood Creek Project Area data are from Terraphase (2018).

Bold concentrations are greater than the respective ERM values.

[a] Assumes dredging to approximately 2.0 ft at select subtidal locations (W3-06, W3-07, W3-08, W3-41, W3-43, W3-48) and placement of clean sand at select lower riprap locations (W3-12 and W3-27). For subtidal sample locations proposed for dredging, data from the sediment interval below 2 ft (i.e., the -2.5- to -3.0-ft interval for all samples, with the exception of the 3.5- to 4.0-ft interval for WS-07) were used. For location W3-43, there were no data for below the 2.0-ft interval. Sediment concentrations from the -2.5- to -3.0-ft interval of neighboring location W3-44 were used to represent the concentrations from location W3-43 (WS-44 samples generally had higher concentrations than did samples from other neighboring locations for the -2.5- to -3.0-ft interval). For lower riprap sample locations proposed for placement of clean sand, reporting limits were used to represent chemical concentrations of the the clean sand.

dw – dry weight

ERM – effects range median

PCB – polychlorinated biphenyl

Although some sediment concentrations in the Hunters Point Shipyard Parcel F site samples exceeded ERM values, the sediment toxicity test data showed only a limited toxicity response. Furthermore, Battelle et al. (2005) plotted the toxicity response data for the urchin (*S. purpuratus*) larval test against the sediment concentration data and found no dose-response relationship or relationship between actual toxicity response and predicted toxicity response based on exceedance of the respective ERM value. Amphipod (*E. estuaries*) data were also plotted against sediment concentration data (Figures A3-1 through A3-3). Similarly, no dose-response relationship or relationship between actual toxicity response and predicted toxicity response based on exceedance of the respective ERM value was found.

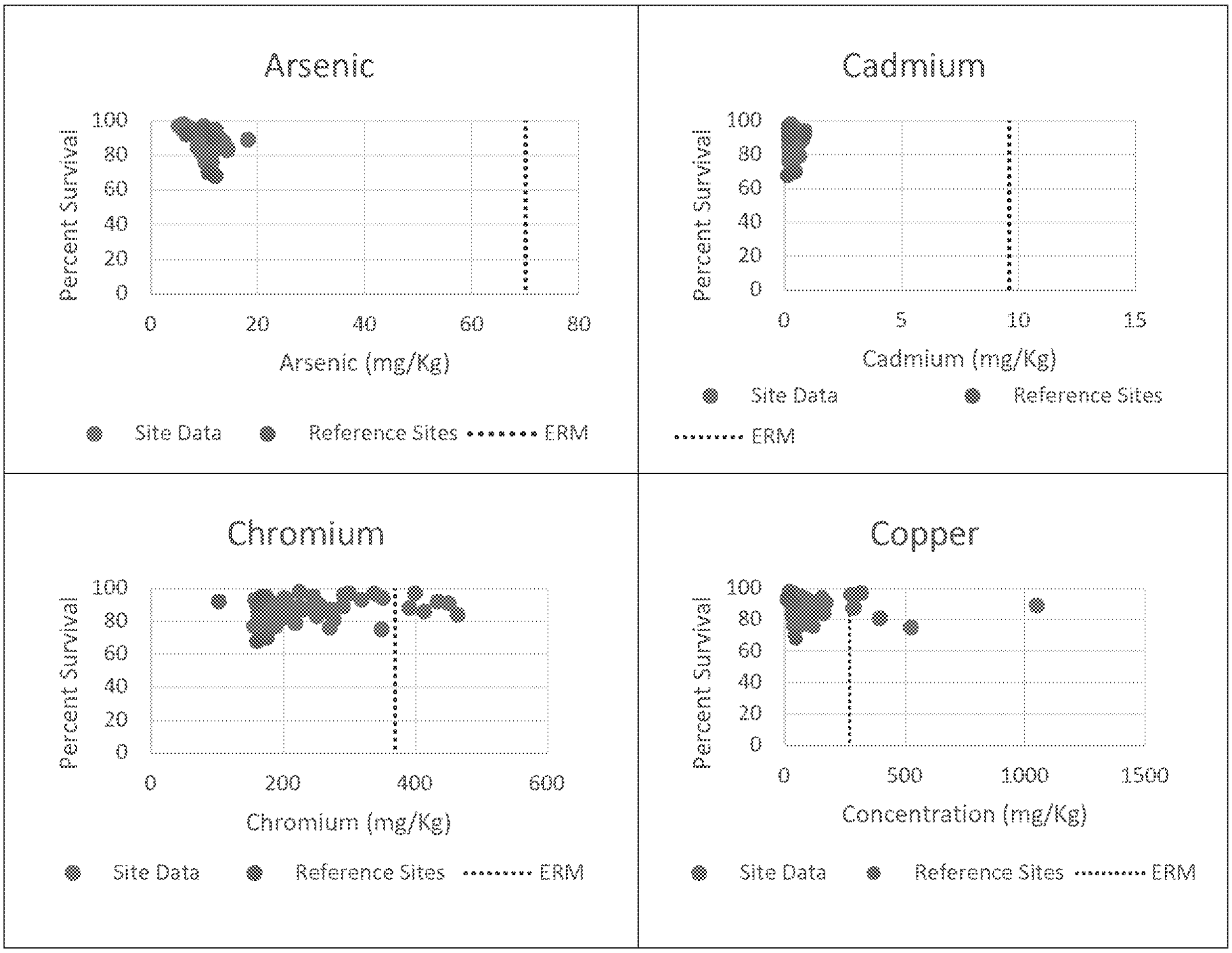


Figure A3-1. *E. estuarius* percent survival plotted against Hunters Point Shipyard Parcel F site surface sediment arsenic, cadmium, chromium, and copper concentrations

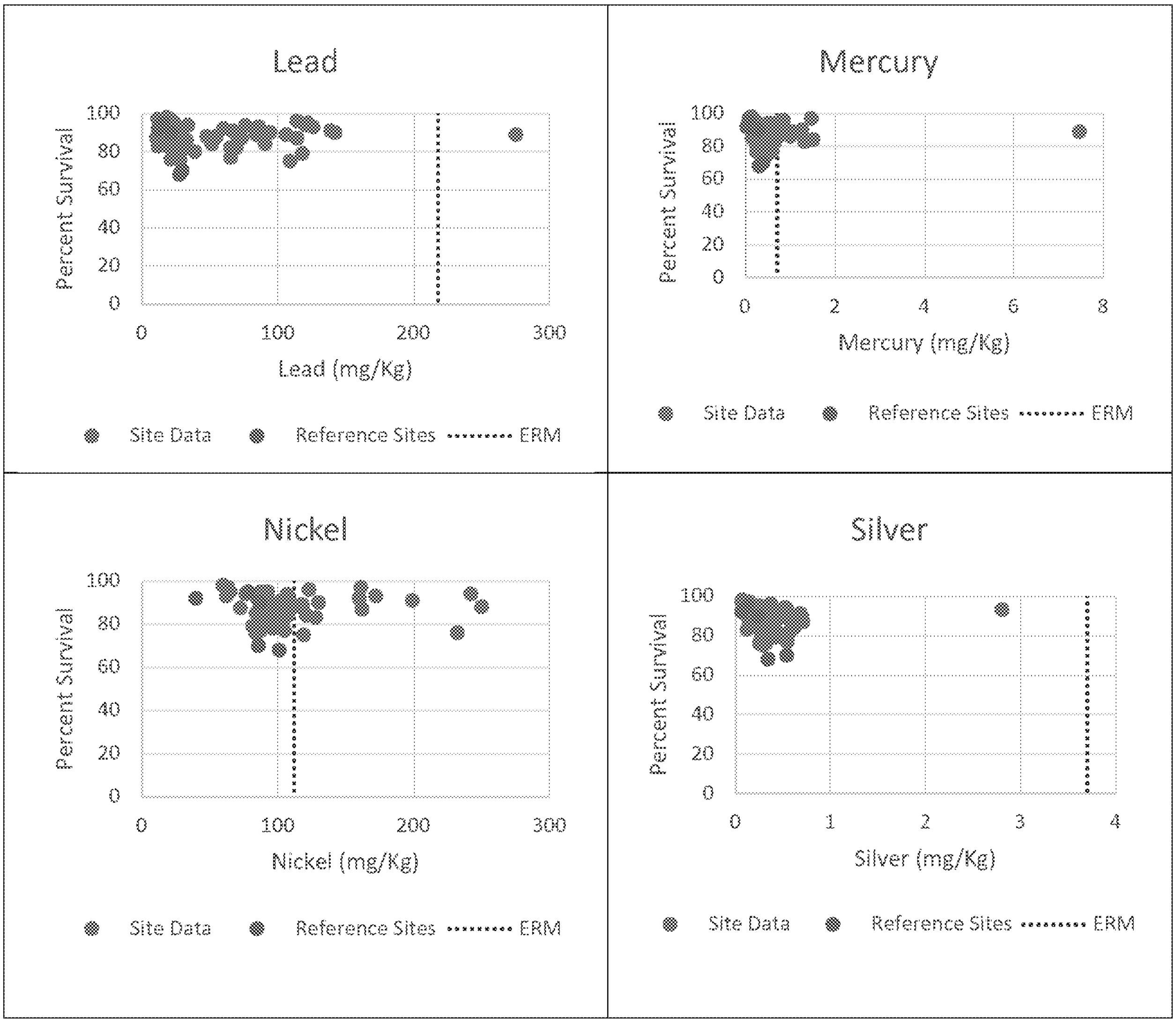


Figure A3-2. *E. estuarius* percent survival plotted against Hunters Point Shipyard Parcel F site surface sediment lead, mercury, nickel, and silver concentrations

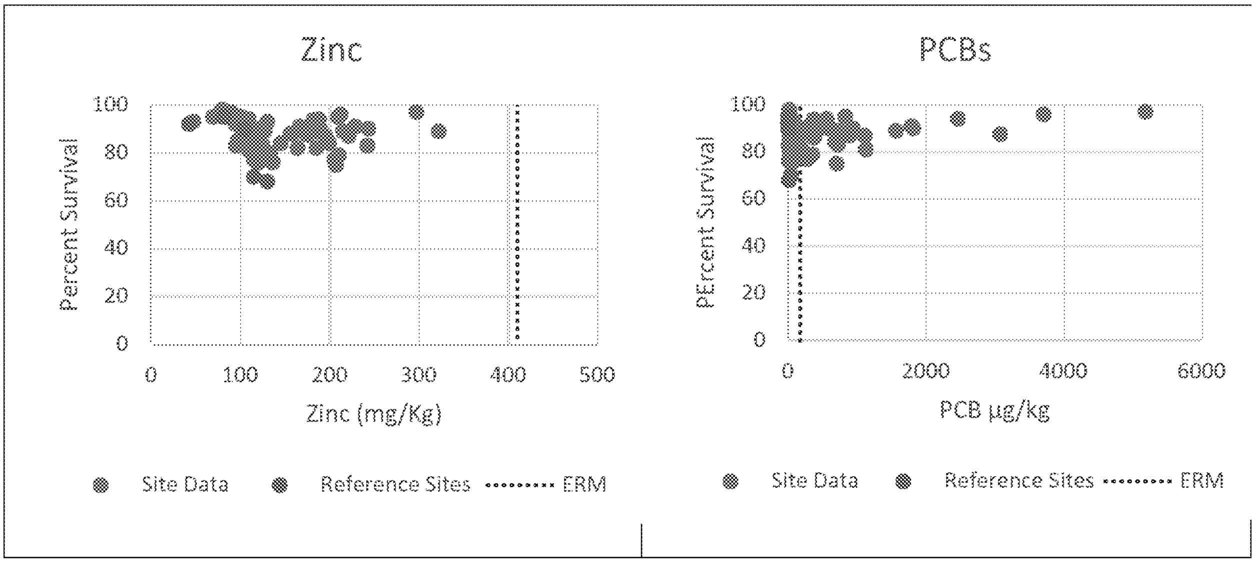


Figure A3-3. *E. estuarius* percent survival plotted against Hunters Point Shipyard Parcel F site surface sediment zinc and PCB concentrations

In addition, no dose response for Hunters Point Shipyard Parcel F site data or reference site data was noted when the toxicity response was plotted with ERM quotient (ERMq) values (Figures A3-4 and A3-5). The ERMqs for the Hunters Point Shipyard Parcel F site included antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, selenium, zinc, total dichlorodiphenyltrichloroethanes (DDTs), dieldrin, endrin, total low-molecular-weight polycyclic aromatic hydrocarbons (LPAHs), total high-molecular-weight polycyclic aromatic hydrocarbons (HPAHs), alpha-chlordane, total PCBs, and tributyltin (TBT). As noted by Battelle et al. (2005), it is not unexpected for toxicity response to be low at locations where a high ERMq is driven by PCBs, because PCBs bioaccumulate but are not acutely toxic. However, toxicity at the Hunters Point Shipyard Parcel F site did not appear to be related to elevated sediment chemical concentrations, even at locations where metals rather than PCBs drove the ERMq (Battelle et al. 2005).

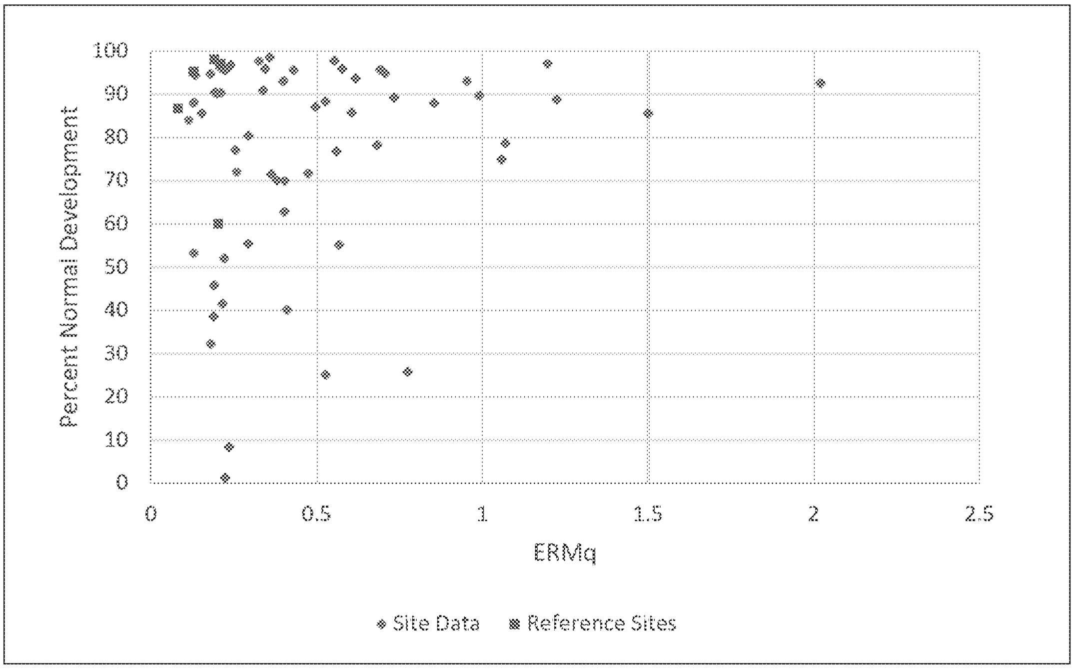


Figure A3-4. *S. purpuratus* normal development data plotted with Hunters Point Shipyard Parcel F site ERM quotient surface sediment values

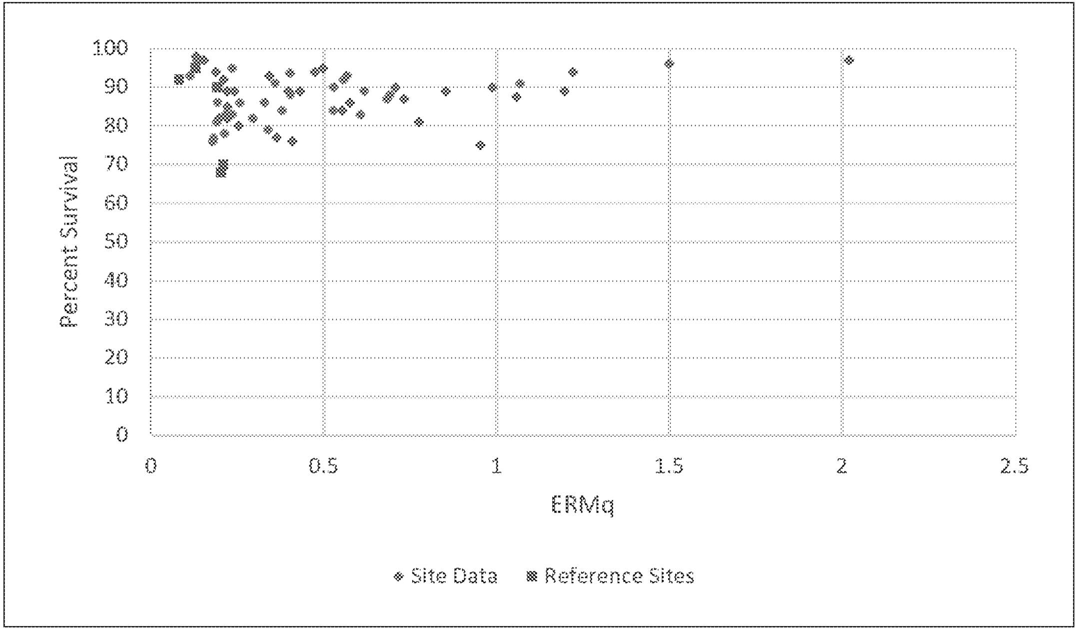
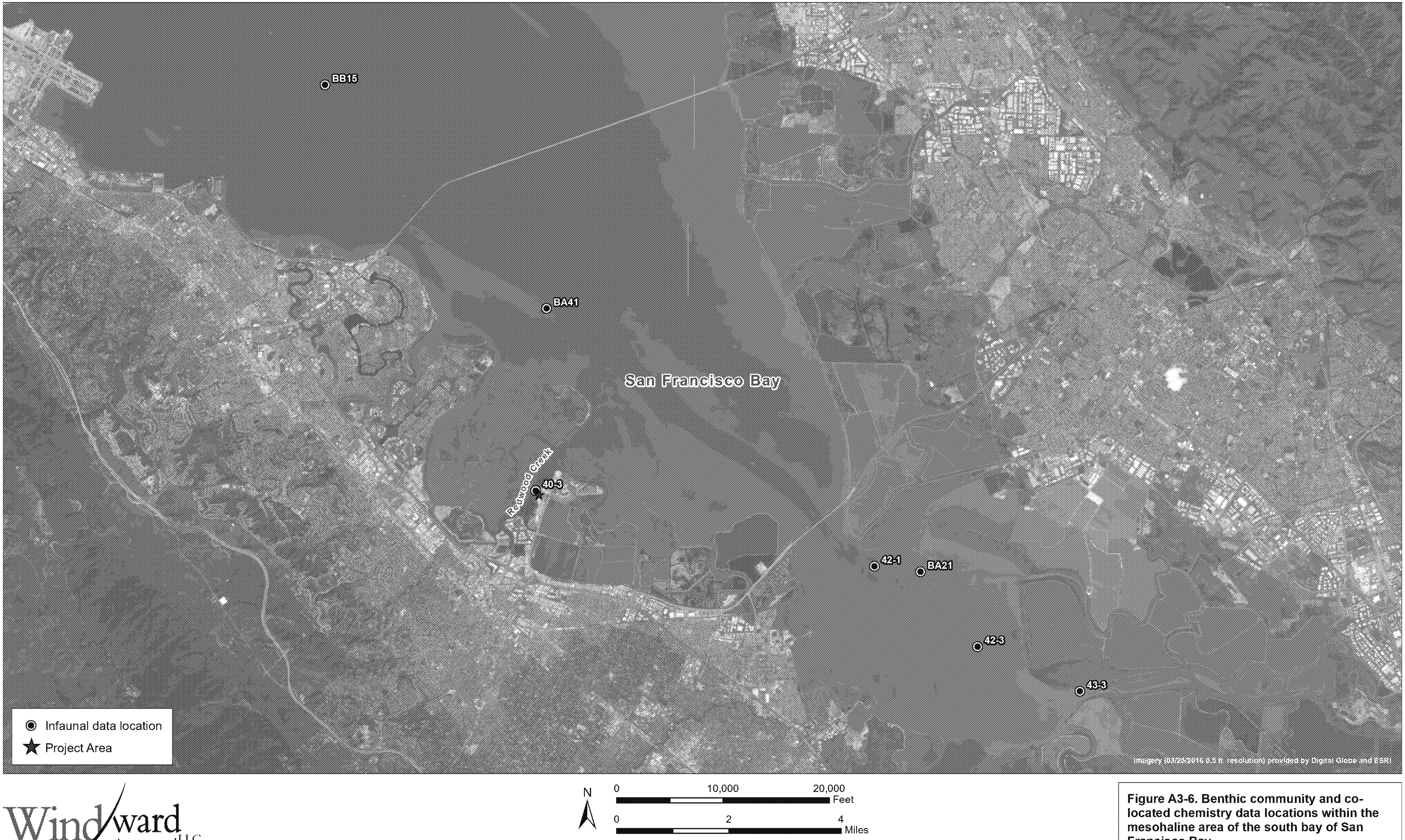


Figure A3-5. *E. estuaries* percent survival data plotted with Hunters Point Shipyard Parcel F site ERM quotient surface sediment values

3.2 SOUTH BAY SAN FRANCISO BENTHIC DATA

The Hunters Point Shipyard Parcel F site toxicity data are in agreement with the benthic community data collected in San Francisco Bay that have been compared to ERMq values. Benthic species richness and *Ampelisca abdita* abundance data from the Southern California Coastal Water Research Program (SCCWRP) California sediment quality objectives database were plotted against ERMq values (for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc) derived from co-located sediment samples within the mesohaline area of the south bay of San Francisco Bay (SCCWRP 2010). Sample locations are provided in Figure A3-6 and include one location in Redwood Creek. No concentration response to species richness or *A. abdita* abundance was found as ERMq values increased (Figures A3-7 and A3-8). This is not surprising, since Dr. Edward Long, the primary developer of the effects-range sediment quality value method, has noted in multiple publications that ERM values should only be used as a screening tool in risk assessments, not as a predictor of effects (Long and Morgan 1990; Long et al. 1995; MacDonald et al. 1996).



Windward environmental LLC

Figure A3-6. Benthic community and co-located chemistry data locations within the mesohaline area of the south bay of San Francisco Bay

REVISED DRAFT

Prepared by mikey, 2/28/2018; W:\Projects\Sims Group\Data\GIS\Maps and Analyses\ERA\Fig A3-6_6751_Benthic community and colocated chemistry data locations.mxd

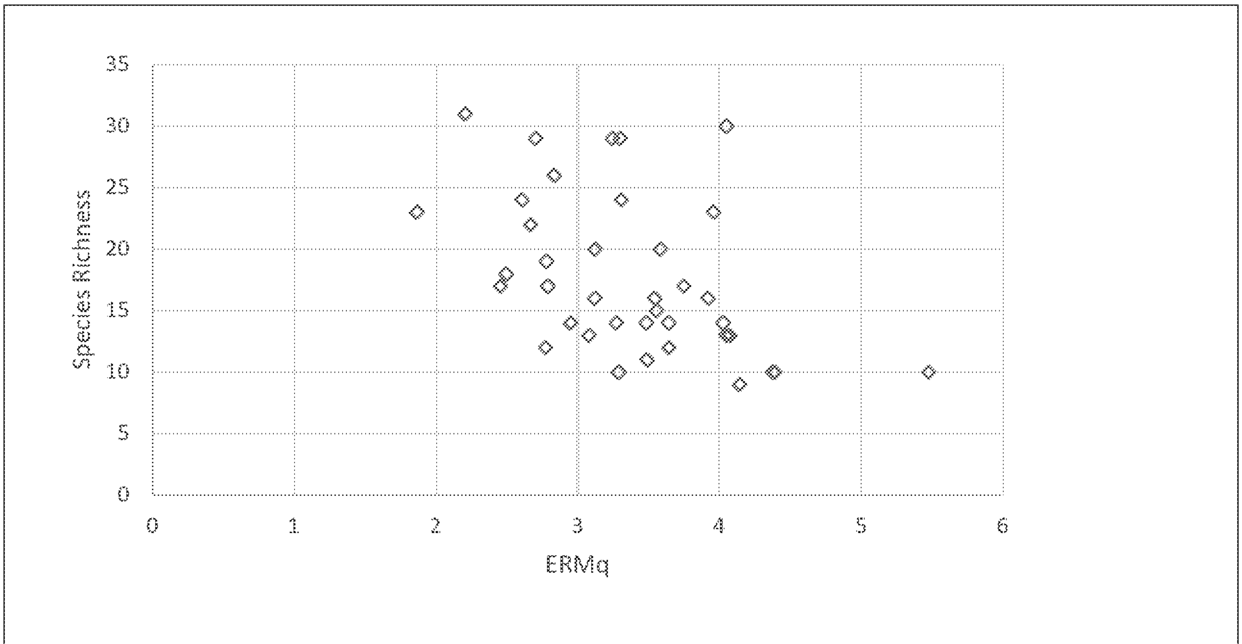


Figure A3-7. Species richness plotted against ERM quotient values of co-located sediment metal concentrations from samples collected in the south bay of San Francisco Bay

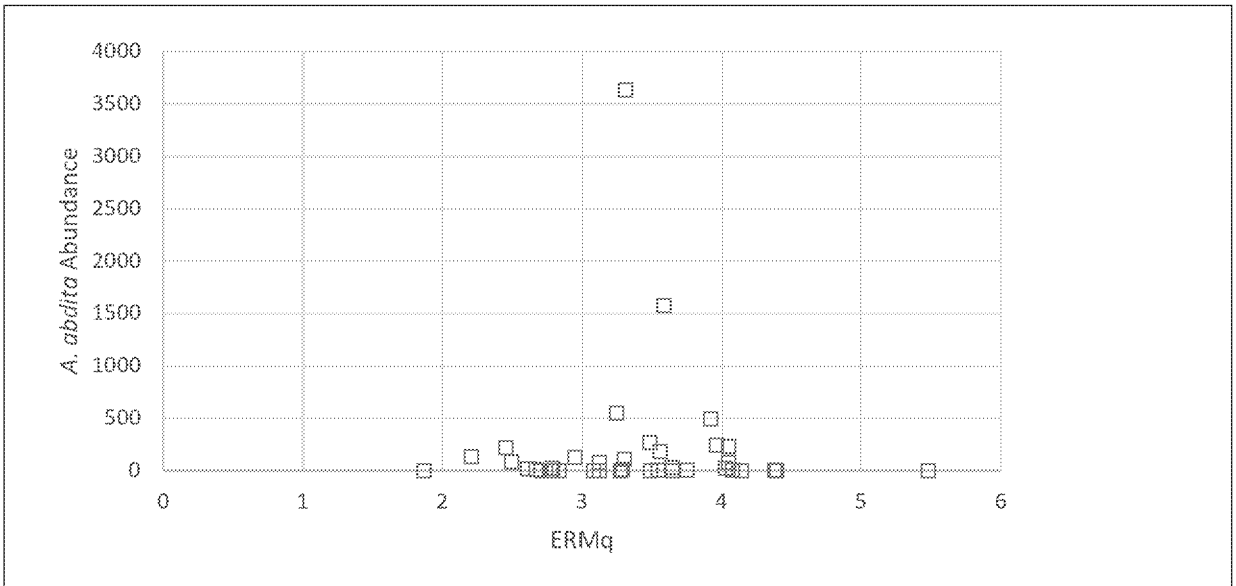


Figure A3-8. *A. abdita* abundance plotted against ERM quotient values of co-located sediment metal concentrations from samples collected in the south bay of San Francisco Bay

Lower riprap/subtidal unit baseline and residual surface sediment concentrations within the Project Area and Hunters Point Shipyard Parcel F site concentration ranges overlap for metals (with the exception of zinc and lead) and total PCBs. The toxicity and community data from the Hunters Point Shipyard Parcel F site and community data from the mesohaline area of the south bay of San Francisco Bay collectively suggest that there is no risk to benthic populations within the Project Area. However, there is some uncertainty for zinc and lead, given the higher zinc and lead concentrations in the sediment in the lower riprap/subtidal unit of the Project Area when compared to the Hunters Point Shipyard Parcel F data.

3.3 SPIKED SEDIMENT BENTHIC TOXICITY DATA

Zinc and lead concentrations found in the baseline and residual Project Area lower riprap/subtidal unit surface sediment were higher than those found at the Hunters Point Shipyard Parcel F site and exceeded the ERM screening values (Table A3-1). To address the potential risk to benthic organisms from zinc and lead concentrations in the range found in Project Area sediment, data from the SCCWRP and Society of Environmental Toxicology and Chemistry (SETAC) spiked sediment toxicity database (SETAC SEDAG and SCCWRP 2018) were reviewed. The database is a compilation of results from sediment toxicity tests in which benthic organisms (mostly amphipods) were tested using clean sediment that was spiked with a known chemical. The test results, therefore, are a direct measure of the cause and effect relationship for the tested chemical. A summary of the test data available in the database, reported as the no observable effect concentrations (NOECs) and lowest observable effect concentrations (LOECs), is presented in Table A3-2.

Table A3-2. Comparison of spiked sediment toxicity data and baseline and residual Project Area lower riprap/subtidal unit surface sediment concentrations

Analyte	Taxa	Species	Endpoint	NOEC Concentration Range (mg/kg)	LOEC Concentration Range (mg/kg)	Project Area Lower Riprap/Subtital Unit Concentration (mg/kg)							
						Baseline				Residual			
						Subtidal		Lower Riprap		Subtidal		Lower Riprap	
						Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Zinc	amphipod	*Melita plumulosa*	survival	1,520–1,770	2,290	163	3,340	232	4,910	163	3,020	3.07	4,910
	bivalve	*Tellina deltoidalis*	survival	4,000	na								
Lead	amphipod	*Leptocheirus plumulosus*	survival	3,820–5,260	795–3,820	32.6	2,240	13	46.2	32.6	685	1.53	469
	amphipod	*Melita plumulosa*	survival	580–3,560	na								

LOEC – lowest-observed-effect concentration
na – not available
NOEC – no-observed-effect concentration

The results in Table A3-2 show that lower riprap/subtidal unit surface sediment baseline (163 to 4,910 mg/kg) and residual (3.07 to 4,910 mg/kg) zinc concentrations overlap with NOEC (1,520 to 4,000 mg/kg) and LOEC (2,290 mg/kg) concentrations. Similarly, the lower riprap/subtidal unit surface sediment baseline (32.6 to 2,240 mg/kg) and residual (1.53 to 685 mg/kg) concentration ranges for lead are within the ranges for NOECs (580 to 5,260 mg/kg) and LOECs (795 to 3,820 mg/kg). Regional toxicity and community data, in conjunction with the spiked sediment toxicity data, suggest that there may be minimal baseline and residual risk to benthic community populations within the Project Area.

4 References

Battelle, BBL, Neptune. 2005. Final. Hunters Point Shipyard Parcel F validation study report. San Francisco Bay, California. Battelle; Blasland, Bouck & Lee, Inc.; and Neptune & Company.

Long ER, Morgan LG. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration, Seattle, WA.

Long ER, MacDonald DD, Smith SL, Calder FD. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environ Manage 19:81-97.

MacDonald DD, Carr RS, Calder FD, Long ER, Ingersoll CG. 1996. Development and evaluation of sediment quality guidelines for Florida coastal waters. Ecotoxicology 5:253-278.

SCCWRP. 2010. California sediment quality objectives database [online]. Southern California Coastal Water Research Project. Updated January 15, 2010. Available from: http://sccwrp.org/Data/SearchAndMapData/DataCatalog/CaliforniaSedimentQualityObjectivesDatabase.aspx.

SETAC SEDAG, SCCWRP. 2018. Spiked sediment toxicity database [online]. Society of Environmental Toxicity and Chemistry Sediment Advisory Group and Southern California Coastal Water Research Project. Available from: http://data.sccwrp.org/sedag/index.php.

Terraphase. 2018. Final. Sediment investigation report, Sims Metal Management, Redwood City, California. Terraphase Engineering Inc., Oakland, CA.

Attachment B. Avian Wildlife TRV References

1 Introduction

Table B1 presents the list of references consulted in the toxicity reference value (TRV) literature review. From this comprehensive review, TRVs were selected for use in the Redwood Creek ecological risk assessment (ERA).

Table B1-1. Summary of bird TRV references reviewed

Chemical	Sources reviewed
Chromium	Chung et al. (1985); Jensen and Maurice (1980); Lien et al. (2004); Romoser et al. (1961)
Cobalt	Diaz et al. (1994)
Vanadium	Davis et al. (2002); Ousterhout and Berg (1981); White and Dieter (1978)

TRV – toxicity reference value

2 References

Chung KH, Sukgrand YO, Kang MH. 1985. The toxicity of chromium and its interaction with manganese and molybdenum in chicks. Kor J Anim Sci 27(6):391-395.

Davis EG, Miles RD, Butcher GD, Comer CS. 2002. Effects of dietary vanadium on performance and immune responses of commercial egg-type laying hens. J Appl Anim Res 22:113-124.

Diaz GJ, Julian RJ, Squires EJ. 1994. Lesions in broiler chickens following experimental intoxication with cobalt. Avian Dis 38(2):308-316.

Jensen LS, Maurice DV. 1980. Dietary chromium and interior egg quality. Poult Sci 59(2):341-346.

Lien TF, Chen KL, Wu CP, Lu JJ. 2004. Effects of supplemental copper and chromium on the serum and egg traits of laying hens. Brit Poult Sci 45(4):535-539.

Ousterhout LE, Berg LR. 1981. Effects of diet composition on vanadium toxicity in laying hens. Poult Sci 60:1152-1159.

Romoser GL, Dudley WA, Machlin LJ, Loveless L. 1961. Toxicity of vanadium and chromium for the growing chick. Poult Sci 40:1171-1173.

White DH, Dieter MP. 1978. Effects of dietary vanadium in mallard ducks. J Toxicol Environ Health 4:43-50.

APPENDIX C

EPA LETTER, DATED AUGUST 23, 2018

AUG 2 3 2018

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX – PACIFIC SOUTHWEST REGION
75 Hawthorne Street
San Francisco, CA 94105-3901

<u>CERTIFIED MAIL:</u> **7015 0640 0001 1122 1588**
<u>RETURN RECEIPT REQUESTED</u>

Mr. Scott Miller, Esq.
Chief Corporate Counsel
Sims Metal Management
555 Theodore Fremd Avenue, Suite C-300
Rye, New York 10580

Re: United States v. Sims, Consent Decree 3:14-cv-04209 (12/1/2014)

Dear Mr. Miller:

I am writing to summarize our meeting on July 18, 2018 and to provide the U.S. Environmental Protection Agency's (EPA) comments on the March 1, 2018, Draft Ecological Risk Assessment Report (Draft ERA) for Sims Metal Management's Port of Redwood City Wharf 3 Area. Sims prepared the Draft ERA in accordance with paragraphs 18 and 19 of the above-referenced Consent Decree, which requires Sims to describe how it intends to remediate sediment within its EPA-approved Sediment Sampling and Analysis Plan's (SSAP) sampling area in a Sediment Remediation Plan (SRP). The Consent Decree requires that the SRP include an evaluation of various alternatives for removal of scrap metal and PCBs in the sampling area, *e.g.*, dredging. The Consent Decree also requires that the SRP include the potential impacts associated with disturbance of the sediment as part of remediation activities, such as dredging, and provides that Sims may propose to leave the sediments and agglomerated scrap metal in place if supported by the result of an ERA. The conclusion reached by Sims in its Draft ERA was that the SRP would involve leaving all sediment in place.

The following is a summary of our July 18 discussion of options to address contaminants in Project Area and comments on the March 1, 2018 Draft ERA:

1. EPA did not believe the Draft ERA's focus on the ecological risk associated with dredging precluded the availability of other various alternatives for sediment remediation in the sampling area. For instance, the Draft ERA did not address or preclude a remediation alternative involving capping sediments in the upper and lower rip-rap where metals concentrations exceed California Hazardous Waste Levels (Total Threshold Limit Concentrations, or TTLC) to prevent further release of these pollutants to the marine environment. Consequently, for the areas in the upper and lower rip-rap where metals concentrations were above TTLC values, we agreed during our meeting that Sims propose options to cap the sediments to prevent future release to the environment. Please include in the SRP the areas to be capped, the physical characteristics of the cap (*e.g.*, material type and thickness, structural integrity requirements, maintenance requirements), the installation techniques used, especially of portions impacted by tidal action, and the permits necessary to allow cap installation (BCDC, Water Board, and Army Corps Section 404 and/or Section 10 permits).

2. During our meeting, EPA expressed its concern with leaving in place any contaminant "hot spots" in sediment in which metals concentrations exceed TTLC near Wharf 3. In its March 1, 2018 SSAP, Sims identified several sub-tidal sediment samples near Wharf 3 where metals concentrations exceed California TTLC (see Enclosure). Sims's use of a Site Use Factor of 0.03 in its Draft ERA risks masking high levels of metals and PCBs in the SSAP sampling area, especially near Wharf 3. Given that arsenic, copper, zinc, and lead concentrations above TTLC were observed at surface and at a depth of approximately 2 feet below the surface, EPA and Sims agreed at our meeting that Sims would propose in the SRP options to remove the sub-tidal sediment in the area containing metals with concentrations at or above TTLC levels. For the sub-tidal sediment removal, please include in the SRP the area that will be removed, the depth of sediment removed, the techniques employed (including disposal), and the permits expected to be needed to perform the work.

3. EPA agreed to accept a revised ERA from Sims, with the possibility that it might support leaving some sediment in place within the SSAP sampling area, assuming the remediation activities discussed during our meeting -- *i.e.*, removal of subtidal sediment contaminant "hot spots" near Wharf 3 and capping of upper and lower rip-rap where contaminants exceed TTLC levels – are implemented.

For purposes of the 90-day timeframe for submitting the revised SRP, we agreed that the 90-day clock began on the day of our meeting, July 18, 2018, and will end on October 16, 2018.

Thank you for meeting with us on July 18, 2018. We believe the meeting enabled us to share ideas on how to best address the observed contamination at the site as identified through the sampling performed by Sims. We look forward to receiving your SRP on or before October 16, 2018. If you have any questions, please don't hesitate to call Lawrence Torres in the Enforcement Division at (415) 947-4211, or Rich Campbell in our Office of Regional Counsel at (415) 972-3870.

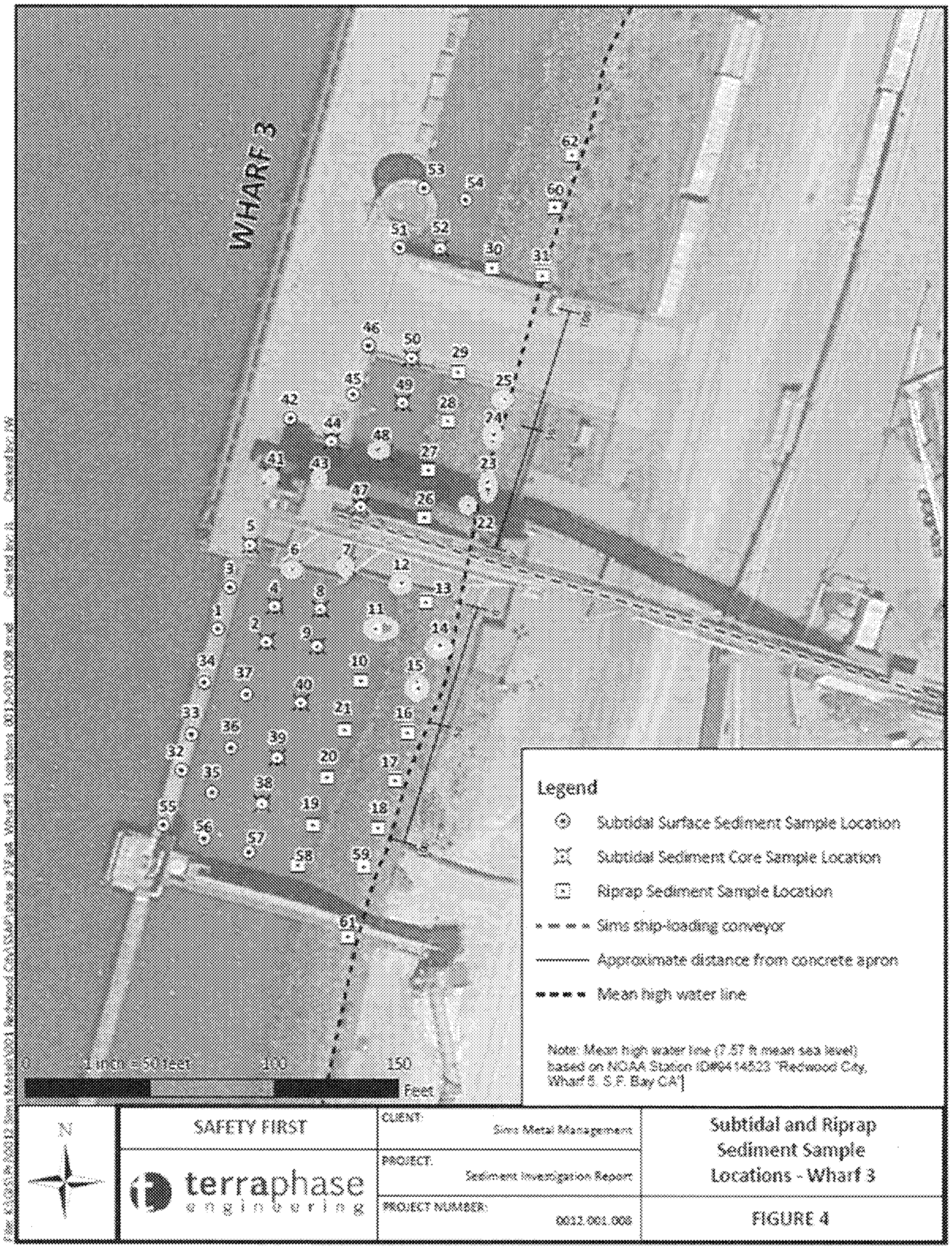
Sincerely,

David Wampler, Chief
Water Enforcement Section II

Enclosure

cc: Meg Rosegay, Esq.

Enclosure 1.



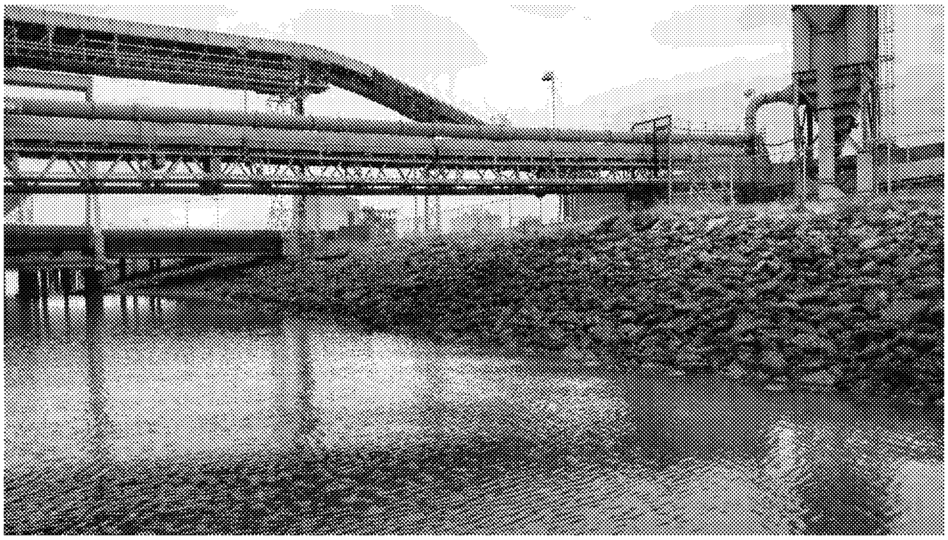
* Highlights were added by EPA to identify sample locations where metals concentrations exceeded the TTLC.

APPENDIX D
PHOTO DOCUMENTATION

Photograph 1: Riprap area where the concrete apron and the Conveyor meet the shoreline.

Photograph 2: View of the Project Area south of the concrete apron and the Conveyor.

	**Photograph 3:** Riprap area where the vehicle ramp meets the shoreline.
	**Photograph 4:** Riprap area where the concrete apron and the Conveyor meet the shoreline.



Photograph 5:
View from the south of the gypsum conveyor in the foreground and the Sims Conveyor in the background.

SAFETY FIRST	CLIENT: Sims Metal Management	PHOTO LOG
terraphase engineering	PROJECT: Sediment Remediation Plan	
	PROJECT NUMBER: 0012.001.014	PAGE 3